Green Building Code Assessment

International Green Construction Code (IgCC) and Leadership in Energy and Environmental Design (LEED) Comparison and Evaluation

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List of Abbreviations:

ANSI	–	American National Standards Institute
ASA	–	Acoustical Society of America
ASCE	–	American Society of Civil Engineers
ASHRAE	–	American Society of Heating, Refrigerating and Air Conditioning Engineers
BMP	–	Best Management Practices
EA	–	LEED Energy and Atmosphere
ESD	–	Environmental Site Design
ETS	–	Environmental Tobacco Smoke
IAQ	–	Indoor Air Quality
IBC	–	International Building Code
ID	–	LEED Innovation and Design
IEBC	–	International Existing Building Code
IECC	–	International Energy Conservation Code
IEQ	–	LEED Indoor Air Quality
IgCC	–	International Green Construction Code
IMC	–	International Mechanical Code
IPC	–	International Plumbing Code
LBC	–	Living Building Challenge
LEED	–	Leadership in Energy and Environmental Design
MDOT	–	Maryland Department of Transportation
MEP	–	Maximum Extent Practical
MERV	–	Minimum Efficiency Reporting Value
MR	–	LEED Materials and Resources
NC	–	LEED for New Construction
NSPC	–	National Standard Plumbing Code
O&M	–	Operations and Maintenance
S.B. 208	–	Maryland High Performance Buildings Act
SMACNA	–	Sheet Metal and Air Conditioning National Contractors Association
SRI	–	Solar Reflectance Index
SS	–	LEED Sustainable Sites
VOC	–	Volatile Organic Compounds
WE	–	LEED Water Efficiency
zEPI	–	Zero Energy Performance Index

Executive Summary

Background

In 2008, Maryland enacted the Maryland High Performance Buildings Act (S.B. 208) which requires that capital projects involving the construction or major renovation of buildings funded solely with state funds meet the criteria for classification as a "high performance building." These structures are defined as buildings that achieve at least a silver rating under the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) rating system.

In 2011, Maryland adopted the International Green Construction Code (IgCC) as an optional requirement for new construction as the first model code that includes sustainability measures for the entire construction project and its site. The IgCC was published as an overlay to the existing set of International Codes to provide model code regulations with clear and specific requirements with provisions that promote safe and sustainable construction, most specifically as a way to govern the impact of buildings and structures on the environment.

As a result of building classification or the use of funding sources other than state funds, most Maryland Department of Transportation (MDOT) structures are exempt from the LEED Silver requirement. Despite these exemptions, and with a pro-active commitment to sustainable development, MDOT requested a comparative analysis of the IgCC requirements against LEED building standards and the existing Maryland Code to ultimately determine the cost and effectiveness of adopting the IgCC as the MDOT building standard. All codes and references used in this analysis are listed in Appendix A.

This Green Building Code Assessment compares and contrasts IgCC, LEED and the Maryland Code with a focus on the cost and time impacts of implementation. This document does not explore the potential benefits and cost savings associated with operations and maintenance of a building constructed to these standards.

Key Findings

- **Comparing the IgCC against LEED can be complicated due to fundamental differences between the two systems.** The LEED rating system is a voluntary green building certification program that evaluates environmental performance from a whole building perspective over a building's life cycle. With LEED, the designer can pick and choose which requirements will be followed based upon a specific project's LEED approach and can choose to incorporate requirements that exceed the minimum credit requirements to achieve additional points. Unlike the LEED rating system, the IgCC consists of model regulations that contain specific, enforceable requirements that promote safe and sustainable construction.

- **Overall, IgCC requirements are more stringent than LEED requirements.** In general, the IgCC regulates more aspects of the construction/operations/maintenance of a building than the LEED rating system. The IgCC is also more stringent when compared in detail to LEED prerequisites and LEED credit minimum points. However, this is not true for every LEED credit; in some cases, if additional points are pursued under a particular credit, the LEED requirements can be more stringent than the IgCC. For example, LEED Materials and Resources (MR) Credit 2, which is

comparable to IgCC Section 503, awards one to two points depending on the amount of waste that is recycled or salvaged. To receive one point under this LEED credit, at least 50 percent of nonhazardous construction waste shall be diverted from disposal; to receive two points, at least 75 percent of nonhazardous construction waste shall be diverted from disposal. This LEED credit is not more stringent than the IgCC standard, as both require a minimum of 50 percent of waste to be diverted, but it does reward a project that exceeds the minimum and attains the higher requirement of 75 percent.

- **Energy Conservation and Water Resource Conservation requirements under the IgCC and LEED have the potential to substantially increase the construction cost of the project.** For example, the IgCC has extensive energy and water metering requirements that are substantially more stringent than LEED requirements. The IgCC also requires that on-site renewable energy be provided, whereas this technology is optional under LEED. Both the IgCC and LEED contain a variety of other Energy Conservation and Water Resource Conservation requirements over and above existing Maryland Code, all of which can increase the cost of construction. **It is important to note, however, that while IgCC and LEED may have a substantial impact on construction costs, substantial cost savings on energy and water may be realized throughout the operation and maintenance of the building as well.**

Chapter Summaries

Chapter 4: Site Development and Land Use

Chapter 4 of the IgCC provides regulations regarding building site development, land use, and natural resources. This chapter is similar in many instances to LEED Sustainable Sites (SS), with comparable intent and requirements. The Maryland Code is primarily comparable under the stormwater management regulations, in which Maryland is more comprehensive than both IgCC and LEED.

Using Maryland Code as the baseline level of effort, the overall standards for this chapter as required by the IgCC would have a **low to moderate impact**, which may result in increased project design and construction costs. Adoption of the IgCC Landscape Irrigation standards may result in a potential increase in time and cost for additional design effort, code review, and a possible increase in materials for water retention. In addition, the IgCC and LEED both establish requirements for Transportation Impacts, Heat Island Mitigation, and Site Lighting which are not covered by the Maryland Code, and these may result in low to moderate increases in project cost and time as well.

Chapter 5: Material Resource Conservation and Efficiency

Chapter 5 of the IgCC provides regulations regarding building materials used during and after construction. This chapter is similar in many instances to LEED MR, with comparable intent and requirements. By contrast, most of this IgCC chapter is not comparable to Maryland Code, which lacks regulation in a number of areas covered by the IgCC and LEED.

Overall, the regulations in this IgCC chapter would have a **low to moderate impact**, and is primarily associated with an increase in cost and time of project planning, documentation, and review. The largest anticipated impact to project cost and time under this IgCC Chapter is via Material Selection regulations due to the traditionally higher cost of salvaged, recycled, recyclable, bio-based, and/or

indigenous materials over cost-effective commodity materials. LEED provides similar requirements and would also require increases in time associated with the process and staff required to complete credit documentation.

Chapter 6: Energy Conservation, Efficiency and CO2e Emission Reduction

Chapter 6 of the IgCC defines requirements for the design and construction of buildings that promote energy conservation and reduction in CO_2 emissions. This chapter is similar in many instances to LEED Energy and Atmosphere (EA), with comparable intent and requirements. In general, IgCC requires a reduction in *energy use*, and LEED requires reduction in *energy costs*, which complicates the comparison of these two standards. The Maryland Code, which is based on the International Energy Conservation Code (IECC), is somewhat comparable to IgCC and LEED, but is overall less stringent.

Adoption of the IgCC Energy standards may potentially have a **high impact**, which may result in increased project design and construction costs. For example, the IgCC requires that separate electrical panels be provided for each load type, and a facility will need to have several meters and sub-meters for each energy source that are capable of transmitting data to an acquisition system. In addition, the IgCC establishes more stringent Modeled Performance Pathway requirements and Building Water Heating System requirements. While these standards under IgCC Chapter 6 may increase up-front design and construction costs, it is important to note that these standards may result in substantial energy cost savings throughout the operations and maintenance of the building as well.

Chapter 7: Water Resource Conservation, Quality and Efficiency

Chapter 7 of the IgCC regulates methods of conserving water, protecting water quality, and providing safe water consumption. This chapter is similar in many instances to LEED Water Efficiency (WE), with comparable intent and requirements. By contrast, most of this IgCC chapter is not comparable to Maryland Code, which lacks regulation in a number of areas covered by the IgCC and LEED.

Overall, there may be a high impact to implementing the IgCC with respect to water resource systems within buildings and building sites. Both the IgCC and LEED specify requirements for water metering, fixtures, fittings, appliances, and systems, which may result in a potentially higher cost and design time. Under the IgCC, all HVAC systems must collect condensate and water discharge for reuse elsewhere on the property; in addition, the IgCC requires in many instances that nonpotable water be used for cooling operations; these are optional under the LEED system. The IgCC also establishes more stringent water metering requirements than LEED, an aspect of building construction not comparable to the Maryland Code. While these standards under IgCC Chapter 7 may increase up-front design and construction costs, it is important to note that these standards may result in substantial water cost savings throughout the operations and maintenance of the building as well.

Chapter 8: Indoor Environmental Quality and Comfort

Chapter 8 of the IgCC regulates indoor air quality, HVAC control, acoustics and daylighting. This chapter is similar in many instances to LEED Indoor Environmental Quality (IEQ), with comparable

intent and requirements. By contrast, most of this IgCC chapter is not comparable to Maryland Code, which lacks regulation in a number of areas covered by the IgCC and LEED.

Implementing these IgCC requirements add an overall **low impact**, which may result in increased project design and construction costs. As a new requirement there is a short learning curve to create and implement the indoor air quality plan required under the IgCC. The required testing as part of the commissioning process will add another layer of testing the Contractor needs to coordinate, but should have a low impact of the completion of the project. IgCC Section 807 specifies optional standards for building acoustics. If these acoustical codes were implemented, there would be a more moderate cost increase for most projects based on the requirement for more substantial wall assemblies. LEED provides similar requirements and would also require increases in time associated with the process and staff required to complete credit documentation.

Chapter 9: Commissioning, Operation and Maintenance

Commissioning is required for all buildings under both IgCC and LEED without exception. The requirements under IgCC are more stringent than the comparable prerequisites and credits under LEED. There is no comparable standard under the Maryland Code.

Implementation of either IgCC for LEED standards would have a **low to moderate impact**, which may increase the cost for the Owner to hire a commissioning agent and to produce additional reports for most MDOT projects. It is not clear if there will be an additional review cost or increase of current review fees to accommodate commissioning review required by the code official. This may vary from jurisdiction to jurisdiction.

Chapter 10: Existing Buildings

Chapter 10 of the IgCC identifies which existing structures shall comply with new construction requirements and which are required to comply with the provisions of this chapter. This chapter also provides exceptions for existing conditions to make compliance with IgCC possible and practical. The IgCC requirement under this chapter for diverting demolition waste from landfills is directly comparable to a credit in LEED. All other requirements under this chapter of the IgCC are only loosely comparable to LEED at best. There are no portions the Maryland Code that are comparable to this chapter of the IgCC either. The implementation of requirements under this IgCC chapter would have an overall **low to moderate impact**, which may result in increased project design and construction costs.

Chapter 11: Existing Building Site Development

Chapter 11 of the IgCC provides regulations regarding additions and alterations to existing and historic building sites. This chapter has similar regulations to the Maryland Code which is based on the International Existing Building Code (IEBC). However, the IEBC is intended for buildings and not building sites. In order to align with the IgCC, Maryland Code would need to include building sites under the existing regulations. The regulations in this chapter of the IgCC would have a **low impact** and is primarily associated with the increased cost of materials required to provide new bicycle parking to an existing site. There are essentially no comparable standards under LEED or the Maryland Code.

IgCC Chapter 4 – Site Development and Land Use

Chapter Summary

Chapter 4 of the International Green Construction Code (IgCC) provides regulations regarding building site development, land use, and natural resources. This chapter is similar in many instances to Leadership in Energy and Environmental Design (LEED) Sustainable Sites (SS), with comparable intent and requirements. The Maryland Code is primarily comparable under the stormwater management regulations, in which Maryland is more comprehensive than IgCC and LEED.

The impact of regulations in IgCC Chapter 4 is low to moderate, and is primarily associated with an increase in cost and time of project planning, documentation and review. This impact is similar for the LEED regulations. Under the stormwater management section, both IgCC and LEED would impact a project with a slight decrease in cost and time due to the more stringent requirements of the Maryland Code.

401 General

IgCC Section 401 is a general description of Chapter 4 and states that the elements governed by the chapter are the development and maintenance of buildings and building sites with the intent to minimize negative environmental impacts. This section of the IgCC also establishes a requirement to produce an inventory of natural resources of the building site. There is no LEED prerequisite or credit that has similar provisions. The Maryland Code, through adoption of the International Building Code (IBC), has comparable provisions in subsection 107.2.

402 Preservation of Natural Resources

IgCC Section 402 provides regulations regarding natural resources in and around the building site, and is intended to preserve, restore, and protect these resources. This section is comparable to LEED SS Credit 1: Site Selection, SS Credit 2: Development Density and Community Connectivity, SS Credit 4.1: Alternative Transportation—Public Transportation Access, and SS Credit 5.1: Site Development—Protect or Restore Habitat, which include similar requirements related to natural resources. The Maryland Code has a comparable provision in IBC Section 1612.

Technical Analysis

IgCC Subsections 402.2 through 402.7 prohibit new construction or development within sensitive environmental areas including flood hazard areas, bodies of water, wetlands, designated conservation areas, public parks, and agricultural land. LEED SS Credit 1 is comparable to these sections of the IgCC. LEED Credit 1 similarly prohibits construction and development within farmland, flood hazard areas, habitats for threatened species, wetlands, near bodies of water, or public parks. LEED and IgCC have equal requirements for each of these conditions except flood hazard areas. Under this provision, IgCC prohibits construction on land that is less than one foot above the IBC requirement and LEED prohibits construction on land that is less than five feet above the 100-year flood line.

IgCC Subsection 402.8 prohibits site disturbance or development in greenfield sites unless one of the following exceptions is met:

- Site is within ¼ mile of densely developed residential land;
- Site is within ¼ mile of diverse uses;
- Site has access to transit services; or
- Site is adjacent to development with connectivity of 90 intersections per square mile.

For greenfield sites that are permitted to be developed, this section of the IgCC also limits the extent of site disturbances. LEED SS Credit 2 is similar to some of these exceptions in that it requires development to occur in a dense community or community with connectivity and diverse uses; however, LEED SS Credit 2 requires that the site also be previously developed. Under this provision, if the LEED credit is obtained, it has a more stringent requirement because the development cannot occur on a greenfield site. LEED SS Credit 4.1 awards points for development sites within proximity to transit services, similar to the IgCC exception. However, LEED SS Credit 4.1 does not stipulate that the site be previously developed, so IgCC and LEED are equal in this regard. LEED SS Credit 5.1 limits the extent of site disturbances for greenfield sites and is equal to the IgCC requirement mentioned above.

Potential Conflicts with Maryland Regulations

IBC Subsection 1612.4 requires that buildings and structures in flood hazard areas shall be in accordance with the American Society of Civil Engineers (ASCE) 7 and 24 which cover minimum design loads and flood resistant design and construction. To be directly comparable and equal to the IgCC, the Maryland Code would require a revision to prohibit construction on land that is less than one foot above the IBC requirement.

Cost and Time Assessment

Using Maryland Code as the baseline level of effort, time, and cost for a project, the standards required by the IgCC would not have an impact on the cost or time of the project because no additional processes, staff, or materials are needed to meet the requirements. LEED would have a low impact as an increase in project time and cost associated with the additional time and staff required to complete credit documentation. Under these provisions, the impact of IgCC is lower than the impact of LEED.

403 Stormwater Management

IgCC Section 403 provides regulations regarding stormwater management and is intended to reduce the impact of stormwater runoff from development sites and reduce stormwater contaminants. This section is comparable to LEED SS Credit 6.1: Stormwater Design-Quantity Control and SS Credit 6.2: Stormwater Design-Quality Control. The Maryland Code has comparable provisions in the Maryland Stormwater Design Manual.

Technical Analysis

IgCC Subsection 403.1 requires that stormwater management systems be provided and maintained on site, and that the systems shall manage and retain rainfall onsite or maintain the predevelopment natural runoff hydrology. LEED SS Credit 6.1 is comparable to this section and requires that predevelopment runoff rates be maintained or reduced depending on the existing

imperviousness of the site. Under these provisions, LEED has a higher standard because it requires a reduction in predevelopment runoff rates for sites with greater than 50 percent impervious surfaces.

IgCC Subsection 403.1 also addresses stormwater management in regards to adjoining properties and brownfields; these provisions are not covered in any LEED prerequisite or credit. IgCC Subsection 403.2 prohibits the use of coal tar sealants in any application exposed to any source of water that could convey the material into soils, surface waters or groundwaters. LEED SS Credit 6.2 addresses the quality of stormwater runoff and requires best management practices to reduce pollutants. This credit is similar in that it addresses pollutants; however, it is more general than IgCC requirements.

Potential Conflicts with Maryland Regulations

The Maryland Stormwater Design Manual includes several performance standards that are comparable to the IgCC requirements regarding stormwater management. Standards 1-7, 9, and 11 include requirements to reduce runoff, increase recharge, and control pollutants. Included is the requirement that post-development annual recharge rates should be the same as predevelopment rates, which is similar to the IgCC requirement. Under these provisions, the Maryland Code is comparable but exceeds the requirements of the IgCC and LEED because it is more inclusive of all factors that impact stormwater quantity and quality.

Cost and Time Assessment

Using Maryland Code as the baseline level of effort, time, and cost, the standards required by the IgCC would not have an impact on the project because Maryland requirements for both stormwater and soils are comprehensive and require significantly more design time and effort.

404 Landscape Irrigation and Outdoor Fountains

IgCC Section 404 provides regulations regarding the irrigation of exterior landscaping and is intended to decrease the amount of potable water used for irrigation. This section is comparable to LEED Water Efficiency (WE) Credit 1: Water Efficient Landscaping. The Maryland Code does not include a comparable standard.

Technical Analysis

IgCC Subsection 404.1 is comprised of two separate requirements. Sub-subsection 404.1.1 requires that landscape irrigation systems must reduce potable water use by 50 percent, or be supplied by reclaimed water. Sub-subsection 404.1.2 requires that irrigation systems be designed to not produce runoff and to irrigate based on weather and plant species requirements. IgCC Sub-subsection 404.1.1 is comparable to LEED WE Credit 1, which requires a reduction in potable water use by 50 percent or use a supply of onsite reclaimed water. However, there is no LEED prerequisite or credit comparable to IgCC Sub-subsection 404.1.2.

IgCC Subsection 404.2 requires that ornamental fountains and water features use only non-potable water. There is no LEED prerequisite or credit comparable to this requirement.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

Based on Maryland Code as the baseline level of effort, time and cost for the project, the standards required by the IgCC would have a moderate impact on project cost and time. This impact would be an increase in time and cost for additional design effort, code review, and a possible increase in materials for water retention. The standards required by LEED would similarly have a moderate impact on the project as an increase in cost due to additional design effort, credit documentation, and a possible increase in materials for water retention.

405 Management of Vegetation, Soils and Erosion Control

IgCC Section 405 provides regulations regarding soils and landscaping, during and after construction, and is intended to protect the quality of soils and water. This section is comparable to LEED SS Prerequisite 1: Construction Activity Pollution Prevention. The 2011 Maryland Standards for Erosion and Sediment Control specifically addresses the construction process. It is comparable and more comprehensive than the requirements in Sub-subsection 405.1.1. The Maryland Stormwater Design Manual Volumes 1 and 2 – referenced in Section 403 – similarly provides more comprehensive provisions protecting the quality of soils and water.

Technical Analysis

IgCC Subsection 405.1 requires that soils must be protected or restored so that they can support vegetation. This subsection also requires that a soil and water quality protection plan be submitted prior to construction that includes the following:

- A soils map, site plan or grading plan;
- An erosion, sedimentation, and pollutant control program; and
- A written maintenance protocol for landscaping.

LEED SS Prerequisite 1 is comparable to IgCC Subsection 405.1, and requires an erosion and sedimentation control plan for construction activities. Under these provisions, IgCC has a higher standard because it also requires a maintenance protocol to be implemented after construction and it is more inclusive of specific requirements for different soil conditions.

IgCC Subsection 405.2 requires that where vegetation, trees, and soils are to be protected, a protection plan must be established. This section also prohibits invasive plant species. Subsection 405.3 requires that areas of new landscaping contain at least 75 percent native plant species. There is no LEED prerequisite or credit that is comparable to these subsections.

Potential Conflicts with Maryland Regulations

The Maryland Stormwater Design Manual provides extensive guidelines and requirements for Best Management Practices (BMP's) impacting water and soil quality. BMP guidelines, with emphasis on Environmental Site Design (ESD) to control impact, is outlined in the manual. Regional watershed factors and localized conditions such as stormwater "hotspots" demand additional provisions to be addressed during the design process. The IgCC requires a comprehensive Concept, Design Development and Final BMP design submission must outline the Maximum Extent Practical (MEP). BMP Performance criteria, with respect to feasibility, conveyance, pretreatment, landscaping and maintenance, are addressed in the manual. Depending on local conditions and MEP criteria, the manual may be more stringent than IgCC or LEED requirements.

Comparable to IgCC Sub-subsection 405.1.1, the 2011 Maryland Standards for Erosion and Sediment Control specifically provides guidance for control of sediment and runoff during construction. The Maryland standard is a comprehensive guide to: planning and design procedures, criteria for grading and stabilization, water conveyance, erosion control filtering, dewatering, and sediment trapping during the construction process. Though the IgCC references specific criteria – such as Subsection 405.03, which is a 75 percent native species requirement – the Maryland Stormwater Design Manual and Maryland Standard for Erosion Control provide a more comprehensive and location specific set of requirements.

Cost and Time Assessment

Using Maryland Code as the baseline level of effort, time, and cost, the standards required by the IgCC would not have an impact on the project because Maryland requirements for both stormwater and soils are comprehensive and require significantly more design time and effort.

406 Building Site Waste Management

IgCC Section 406 provides regulations regarding waste associated with construction and land-clearing, and is intended to reduce disposal of waste. There is no LEED prerequisite or credit comparable to this section, and Maryland Code does not include a comparable standard either.

Technical Analysis

IgCC Subsection 406.1 requires a building site waste management plan that will divert 75 percent of land-clearing debris and excavated soils from disposal. IgCC Subsection 406.2 requires that construction waste shall be managed in accordance with Section 503. There is no LEED prerequisite or credit that is comparable to these subsections.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

Based on Maryland Code as the baseline level of effort, time and cost for the project, the standards required by the IgCC would have a low impact on project cost and time. This impact would be an increase in time and cost for additional planning, documentation, and review. There is no LEED prerequisite or credit that is comparable and therefore LEED would not impact the cost or time of a project under these provisions.

407 Transportation Impact

IgCC Section 407 provides regulations regarding transportation accommodations and is intended to provide facilities for alternative modes of transportation. This section is comparable to LEED SS Credit 4.2: Alternative Transportation—Bicycle Storage and Changing Rooms, Credit 4.3: Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles, and Credit 4.4: Alternative Transportation—Parking Capacity. The Maryland Code does not include a comparable standard.

Technical Analysis

IgCC Subsections 407.1 through 407.3 require appropriate access for bicycles, at least one shower and changing facility for every 20 long term bike parking spaces, and minimum short-term and long-term bike parking spaces depending on building size. LEED SS Credit 4.2 is comparable to this section

and requires bike parking and changing facilities based on building FTE occupants. IgCC and LEED have similar requirements for these facilities.

IgCC Subsection 407.4 requires preferred parking spaces for high-occupancy vehicles and low-emission, hybrid, or electric vehicles for at least five percent each of the total parking required. LEED SS Credit 4.3 and Credit 4.4 are comparable to this section. Credit 4.3 requires preferred parking for low-emitting and fuel efficient vehicles for at least five percent of the total parking, and Credit 4.4 requires preferred parking for carpool vehicles for five percent of total parking. Both of these credits are equal in requirements to the IgCC. However, the LEED credits provide several alternate paths to satisfy the intent of the credit.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

Based on Maryland Code as the baseline level of effort, time and cost for the project, the standards required by the IgCC would have a moderate impact on project cost and time. This impact would be an increase in cost for additional parking facilities as well as shower and changing facilities. The standards required by LEED would also have a moderate impact associated with additional parking facilities as well as shower and changing facilities. LEED would also have an increase in time and cost associated with credit documentation. Under these provisions, the impacts of LEED are slightly higher than IgCC.

408 Heat Island Mitigation

IgCC Section 408 provides regulations regarding site hardscape and roofing materials, and is intended to reduce the heat island effect. This section is comparable to LEED SS Credit 7.1: Heat Island Effect—Nonroof and Credit 7.2: Heat Island Effect—Roof. The Maryland Code does not include a comparable standard.

Technical Analysis

IgCC Subsection 408.2 requires not less than 50 percent of site hardscape shall be provided with any combination of materials, with solar reflectance of not less than .30, are shaded or are pervious. LEED Credit 7.1, requires not less than 50 percent of site hardscape shall be provided with any combination of materials with an SRI of at least 29, are shaded, or are 50 percent pervious. This credit is similar and equal to the IgCC, however it is slightly more specific.

IgCC Subsection 408.3 requires that at least 75 percent of roof surfaces shall have any combination of materials with an SRI 25 for steep slopes, SRI 60 for low slopes, and a vegetated surface. LEED Credit 7.2, Heat Island Effect-Roof, is comparable to this section. This credit requires at least 75 percent of roof surfaces have materials with an SRI 29 for steep slopes, SRI 78 for low slopes, or 50 percent vegetated surface, or a combination of the two. Under these provisions, LEED has a higher standard because it requires a higher SRI for roofing materials.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

Based on Maryland Code as the baseline level of effort, time and cost for the project, the standards required by the IgCC and LEED may have a moderate impact on project cost. This impact would be an increase in cost for a vegetated roof if that option was followed.

409 Site Lighting

IgCC Section 409 provides regulations regarding exterior lighting and is intended to limit glare and light trespass. This section is comparable to LEED SS Credit 8: Light Pollution Reduction. The Maryland Code does not include a comparable standard.

Technical Analysis

IgCC Subsection 409.1 requires that exterior lighting not exceed specified maximum glare ratings for the applicable lighting zone. LEED SS Credit 8 is comparable to this section in its requirements for exterior lighting. However, the LEED credit also includes requirements for interior lighting that intend to further minimize light trespass. Under these provisions, LEED has a higher standard than IgCC, which does not include requirements for interior lighting.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

Based on Maryland Code as the baseline level of effort, time and cost for the project, the standards required by the IgCC would not have an impact on project cost and time. The standards required by LEED would have a low impact associated with an increase in time and staff required for credit documentation. Under these provisions, the impacts of LEED are slightly higher than IgCC.

IgCC Chapter 5 – Material Resource Conservation and Efficiency

Chapter Summary

Chapter 5 of the IgCC provides regulations regarding building materials used during and after construction. This chapter is similar in many instances to LEED Materials and Resources (MR), with comparable intent and requirements. By contrast, most of this IgCC chapter is not comparable to Maryland Code, which would require revisions to provide similar regulations and to meet the intent and requirements set forth in the IgCC.

The impact of the regulations in this chapter is low to moderate, and is primarily an increase in cost and time of a project associated with planning, documentation and review. There is one requirement for dedicated space that may impact the project as additional materials. Also, there could be a substantial impact on the cost of the project due to the fact that salvaged, recycled, recyclable, bio-based, and/or indigenous materials typically cost more than cost-effective commodity materials.

501 General

IgCC Section 501 provides a general description of IgCC Chapter 5 and states that the elements governed by the chapter include building materials conservation, resource efficiency, and environmental performance. This section does not include any specific regulations.

502 Construction Material Management

IgCC Section 502 provides regulations regarding the construction phase of a project and is intended to ensure proper storage and handling of materials to guarantee safety and avoid damage. This section is comparable to LEED IEQ Credit 3.1: Construction Indoor Air Quality Management Plan- During Construction, which is intended to reduce air quality problems during construction. The Maryland Code comparable to this section is IBC 3301.2, which regulates the storage and placement of materials during construction.

Technical Analysis

IgCC Sub-subsection 502.1.1 requires that materials stored and handled during construction should comply with the manufacturers' instructions. IgCC Sub-subsection 502.1.2 requires that materials subject to moisture damage should be protected from moisture during construction and that if materials are damaged by moisture, those materials should be properly cleaned or replaced. LEED IEQ Credit 3.1 is comparable to this section and requires an indoor air quality management plan that includes protection of stored on-site and installed absorptive materials from moisture damage. This plan also requires control measures for air handlers and filtration, which are not covered by this section of the IgCC. In regard to moisture control and protection during construction, the IgCC and LEED have equal requirements.

Potential Conflicts with Maryland Regulations

Through adoption of the IBC 2012, and stated in IBC 3301.2, Maryland Code requires that during construction, equipment, and materials shall be stored so as not to endanger the public, workers, or adjoining property. The IgCC standard for storing and handling of materials is similar to Maryland's requirement. However, the Maryland Code does not have a requirement that specifically covers moisture protection during construction or that is comparable to IgCC 502.1.2 or LEED IEQ Credit

3.1; therefore, the IgCC and LEED have a higher standard than Maryland for moisture protection during construction. To be comparable to the IgCC and LEED, the Maryland Code would need to be revised to include standards for moisture protection during construction.

Cost and Time Assessment

Using Maryland Code as the baseline level of effort, the standards required by the IgCC would not impact the cost or time of the project because no additional processes, staff or materials are needed to meet the standard. The standards required by LEED would have a low impact as an increase in cost due to additional time and process required for development of the indoor air quality management plan and credit documentation.

503 Construction Waste Management

IgCC Section 503 provides regulations regarding the construction phase of a project and is intended to reduce construction waste disposal. It requires that a construction material and waste management plan be developed and implemented to recycle or salvage construction materials and waste. This section is comparable to LEED MR Credit 2: Construction Waste Management, which is intended to divert construction and demolition debris from disposal. The Maryland Code does not include a comparable standard.

Technical Analysis

IgCC Subsection 503.1, requires that not less than 50 percent of nonhazardous construction waste shall be diverted from disposal. This is to be achieved by developing and implementing a construction material and waste management plan that describes how, where, and what materials will be recycled or salvaged. Materials considered under this provision do not include land-clearing debris or excavated soils and fill, which are covered in IgCC Section 406.1.

LEED MR Credit 2 is comparable to this section of the IgCC and awards one to two points depending on the amount of waste that is recycled or salvaged. To receive one point under this LEED credit, not less than 50 percent of nonhazardous construction waste shall be diverted from disposal; to receive two points, not less than 75 percent of nonhazardous construction waste shall be diverted from disposal. The credit also requires that a construction waste management plan be developed and implemented that describes how and what materials will be recycled or salvaged. This LEED credit is not more stringent than the IgCC standard, as both require a minimum of 50 percent of waste to be diverted, but it does reward a project that exceeds this and meets a higher minimum requirement of 75 percent of waste diverted.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

Given that there is no comparable standard in the Maryland Code, the standards required by the IgCC would have a low impact on the cost and time of the project. This impact would be an increase in the cost and time of the project and is associated with the time and staff required to develop and properly document the construction material and waste management plan. The standards required by LEED would also have a low impact on the cost and time of the project. This impact would be an increase in the cost and time of the project and is associated with the time and staff required to

develop and properly document the construction material and waste management plan. The impacts of the IgCC requirements are similar to the impacts of the LEED requirements.

504 Waste Management and Recycling

IgCC Section 504 provides regulations regarding material recycling for a project post-occupancy and is intended to provide space to collect recyclable materials and waste. This section is comparable to LEED MR Prerequisite 1: Storage and Collection of Recyclables, which requires dedicated space for the collection and storage of recyclable materials. The Maryland Code does not include a comparable standard.

Technical Analysis

IgCC Subsection 504.1 requires that space is provided for use by building occupants for storage and recycling of materials in accordance with local regulations. If local regulations do not exist, recycling areas should be provided to accommodate materials based on existing or planned recycling services. They should be designed to meet the needs of occupants and for efficient pick-up.

LEED MR Prerequisite 1 is comparable to this section of the IgCC and requires that dedicated areas be provided for the collection and storage of recyclables, which at a minimum must include paper, cardboard, glass, plastic, and metals. The IgCC and LEED are equal in that they require space for recycling. LEED is more specific in the types of materials that must have space for recycling, which IgCC does not specify unless required by the local jurisdiction.

IgCC Subsection 504.2 requires that space be provided for storage of fluorescent lamps, HID lamps, batteries, electronics, and other materials requiring special disposal by the jurisdiction. There is no LEED prerequisite or credit that is comparable to this section.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

Given that there is no comparable standard in the Maryland Code, the standards required by the IgCC would have a low impact on the cost of the project. This impact would be an increase in the cost associated with additional space and materials required for the storage of recyclables. The standards required by LEED would have a similar low impact on the cost of the project, which would be an increase in cost associated with additional space and materials. In addition, LEED would have a low impact due to an increase in time and cost associated with time and staff required to complete the credit documentation.

505 Material Selection

IgCC Section 505 provides regulations regarding selection of building materials and is intended to lessen the impacts of material extraction, processing, and transport. This section is comparable to the combination of LEED MR Credit 3, Credit 4, Credit 5, Credit 6, and Credit 7 which award points for building material selections that lessen the impacts of material extraction, processing, and transport. The Maryland Code does not include a comparable standard.

Technical Analysis

IgCC Subsection 505.2 requires that not less than 55 percent of the total building materials used in the project − based on mass, volume, or cost − must be used (i.e. salvaged), recycled, recyclable, bio-based, or indigenous (within 500 miles). LEED MR Credit 3: Materials Reuse requires that five percent of materials be salvaged, refurbished, or reused, and awards an additional point if 10 percent of materials are salvaged, refurbished or reused. LEED MR Credit 4: Recycled Content requires that 10 percent of those materials be recycled, and awards an additional point if 20 percent of materials are recycled. LEED MR Credit 5: Regional Materials requires that 10 percent of materials be indigenous (within 500 miles), and awards an additional point if 20 percent of materials are indigenous. LEED MR Credit 6: Rapidly Renewable Materials requires that two and a half percent of materials are plant-based rapidly renewable materials. LEED MR Credit 7: Certified Wood requires that a minimum of 50 percent (based on cost) of wood-based materials and products that are certified in accordance against the USGBC Forest Certification Benchmark, for wood building components. The IgCC is slightly more stringent under these provisions when the IgCC minimum amount of qualifying materials (55 percent) is compared to the total amount of qualifying materials required to earn the maximum points from the four LEED credits (52.5 percent).

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

Given that there is no comparable standard in the Maryland Code, the standards required by the IgCC would have a minimal impact on time. However, it could have a substantial impact on the cost of the project due to the fact that salvaged, recycled, recyclable, bio-based, and/or indigenous materials typically cost more than cost-effective commodity materials. LEED would require an increase in time associated with the process and staff required to complete credit documentation, and it could also have a substantial impact on the cost of the project as well, due to the fact that salvaged, recycled, recyclable, bio-based, and/or indigenous materials typically cost more than cost-effective commodity materials.

506 Lamps

IgCC Section 506 provides regulations regarding the content of low mercury lamps used in the building project. There is no LEED prerequisite or credit that applies to lamps and the Maryland Code does not include a comparable standard either.

Technical Analysis

IgCC Subsection 506.2 states that straight fluorescent lamps shall not contain more than five milligrams of mercury per lamp. IgCC Subsection 506.3 states that compact fluorescent lamps shall not contain more than five milligrams of mercury per lamp, and includes requirements for labeling of lamps.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

Despite that there is no comparable standard in the Maryland Code or LEED, the standards required by the IgCC would have a minimal impact on the cost and time of the project because no additional processes, staff, or materials are needed to meet the standard.

507 Building Envelope Moisture Control

IgCC Section 507 provides regulations regarding moisture control and preventative measures, and is intended to ensure proper inspection of building elements related to moisture control. There is no LEED prerequisite or credit that applies to moisture control and the Maryland Code does not include a comparable standard either.

Technical Analysis

IgCC Subsection 507.1 states that moisture preventative measures shall be inspected in accordance with IgCC Sections 902 (Approved Agency) and 903 (Commissioning). The items that must be in accordance are as follows:

- Foundation sub-soil drainage system
- Foundation waterproofing
- Foundation dampproofing
- Under slab water vapor protection
- Flashings
- Exterior wall coverings
- Roof coverings, drainage and flashings

There is no LEED prerequisite or credit that applies to moisture control.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

Given that there is no comparable standard in the Maryland Code or LEED, the standards required by the IgCC would have a moderate impact on the cost and time of the project. This impact would be an increase in the cost and time associated with the time and staff required for commissioning and inspection during construction and post-occupancy.

IgCC Chapter 6 – Energy Conservation Efficiency and CO_2 Emissions Reduction

Chapter Summary

Chapter 6 of the IgCC defines requirements for the design and construction of buildings that promote energy conservation and reduction in CO_2 emissions. The analysis provided for this chapter primarily compares the IgCC with the Maryland Code, which is based on the International Energy Conservation Code (IECC), and LEED Energy and Atmosphere (EA) prerequisites and credits.

IgCC Chapter 6 requires the following major elements be incorporated in the design and construction of buildings:

- Design following one of two pathways;
- Performance-based compliance (Section 602);
- Prescriptive-based compliance (Sections 605, 606, 607, 608, 609);
- Provide metering of all forms of energy delivered to the building, or produced onsite and segregated by use type (Section 603);
- Provide either onsite renewable energy systems for at least two percent of the building's total annual energy use, or a 10 year commitment to purchase renewable energy credits for at least four percent of the building's total annual energy use, or provide a combination of onsite renewable energy and purchase renewable energy credits for at least four percent of the building's total annual energy use (Section 610); and
- Perform commissioning (Section 611).

The majority of the sections within IgCC Chapter 6 relate to the performance-based and prescriptive-based compliance requirements. IgCC performance-based compliance requires that ASHRAE 90.1 energy modeling with modifications identified within IgCC be performed to demonstrate that a building's total energy performance is at least a 10.5 percent improvement over the baseline building that minimally follows the prescribed requirements of the Maryland Code based upon total energy use. IgCC prescriptive-based compliance requires that the design to follow prescriptive requirements for various building components that generally exceed the requirements identified in the Maryland Code by approximately 10 percent. Either path can be utilized for all building types.

The Maryland Code provides prescriptive requirements for the design and construction of building components and systems (insulation, fenestration, power consumption, etc.) that are applicable to all buildings. These requirements must be followed by the designer, but in the event that the designer wants to violate one of more of these requirements, the Code permits these violations provided that ASHRAE 90.1 energy modeling is performed to demonstrate that the buildings total energy performance is equal to or better than if the building were to minimally follow the prescribed requirements of the Maryland Code based upon total energy cost

The LEED Section most applicable to IgCC Chapter 6 is EA, which is comprised of three prerequisites and six credits and offers 35 possible points, more than any other LEED Section.

601 General

IgCC Section 601 provides a general description of IgCC Chapter 6 and is intended to provide flexibility to permit the use of innovative approaches and techniques to achieve the effective use of energy. The purpose of this section is to introduce general guidance regarding the design, construction, commissioning, and operation of buildings and their associated sites for the effective use of energy. This section does not include any specific regulations.

602 Modeled Performance Pathway Requirements

IgCC Section 602 defines performance based compliance project requirements pertaining to energy use and CO_2 emissions. LEED EA Prerequisite 2: Minimum Energy Performance- Option 1, and EA Credit 1: Optimize Energy Performance- Option 1 are comparable to this Section of the IgCC.

Technical Analysis

IgCC Section 602 and its subsections require a 10.5 percent reduction in total energy use based upon an ASHRAE 90.1 energy model that is performed in compliance with the modifications identified within this section. If the jurisdiction incorporates sub-subsection 302.1.1, the total energy use reduction is required to be 19.3 percent or greater. By comparison, LEED EA Prerequisite 2- Option 1 requires a 10 percent reduction in total energy cost, and EA Credit 1- Option 1 provides one point for every two percent further reduction in total energy cost reduction from 12 percent through 48 percent for a possible total of 19 points.

While the EA Prerequisite 2 requirement of 10 percent energy cost reduction appears to be the same the 10.5 percent energy use reduction required in IgCC, these percentages cannot be readily compared as they are based upon different metrics. IgCC requirements are based upon a reduction in total energy use, and LEED requirements are based upon a reduction in total energy cost. Since utility prices vary, there is not a direct relationship between energy use savings and energy cost savings. For this reason it is not possible to say if the IgCC energy modeling requirement is more or less stringent than the LEED energy modeling requirement.

IgCC Section 602 also requires that the annual direct and indirect CO_2 emissions for the proposed design be at least a 10.5 percent improvement over the emissions associated with the baseline building from the ASHRAE 90.1 energy model. LEED and the Maryland Code do not address reduction CO_2 emissions. There is no comparable LEED standard for CO_2 reduction.

Potential Conflicts with Maryland Regulations

There are no substantial conflicts between IgCC, the existing Maryland Code and LEED.

Cost and Time Assessment

Given that the Maryland Code is less stringent than the IgCC, the standards required by IgCC Section 602 would yield a low to moderate increase in project cost and time. The simulations often need to be run, modified, and re-run several times during the design process to ensure the design complies with the energy reduction requirements. However, because an energy use reduction of 10.5 percent is not very difficult to achieve, the model may only need to be run once or twice. If sub-subsection 302.1.1 of the IgCC is incorporated, the model will need to be run several more times, and there will be a moderate increase on project design costs.

The LEED standards would also yield a low to moderate increase in the cost and time of the project.

603 Energy Metering, Monitoring, and Reporting

IgCC Section 603 requires buildings to be constructed in such a way that their energy use, production, and reclamation is measured, monitored, and reported. LEED Minimum Program Requirement #6: Must Commit to Sharing Whole-Building Energy, and Water Usage Data and EA Credit 5: Measurement and Verification are both comparable to this section of the IgCC.

Technical Analysis

IgCC Section 603 and its subsections require that meters be provided to measure the energy use for the whole building and associated project site. This requirement is no different than the LEED Minimum Project Requirement #6, or what would be required by the utility provider. However, this section imposes additional metering requirements that are well above and beyond LEED and utility provider requirements. This section requires that five energy use types (HVAC Systems, Lighting Systems, Plug Loads, Process Loads, and Building Operations and Miscellaneous Other Loads) be isolated and metered. Meters are required to determine total energy use and peak demands for gaseous fuels, liquid fuels, solid fuels, electric power, district heating and cooling, combined heat and power, and renewable and waste energy sources.

This section also requires that a data acquisition and management system be provided capable of storing not less than 36 months worth of data collected by all meters, and capable of calculating the annual CO_2 emissions associated with the operation of the building based upon the annual energy use measurements. In addition, a permanent, readily accessible, and visible display must be provided adjacent to the main building entrance or on a publicly available Internet website showing the current energy demand for the whole building updated for each fuel type at 15 minute intervals, the average and peak demands for the previous day and same day in the previous year, and the total energy usage for the past 18 months.

The LEED Minimum Program Requirement stipulates that all projects must commit to sharing with USGBC all available actual whole-project energy and water usage data for a period of at least 5 years, through a free, accessible and secure online tool. LEED EA Credit 5 provides several options for measurement and verification of actual energy savings through building operations. Together, these standards under LEED are quite broad compared to this section of the IgCC.

Potential Conflicts with Maryland Regulations

There are no substantial conflicts between IgCC, the existing Maryland Code and LEED.

Cost and Time Assessment

Given that the Maryland Code is less stringent than the IgCC, the standards required by IgCC Section 603 would yield a moderate increase in time, and a high increase in project cost. In order to isolate these loads described in this section, separate electrical panels will need to be provided for each load type, and the facility will need to be provided with many meters and sub-meters for the each energy source that are capable of transmitting data to an acquisition system. These requirements will have a high impact on costs to both design and construction.

The LEED standards would have a comparatively low cost and time of the project because does not require submetering, nor does it require the robust reporting identified in the IgCC.

604 Automated Demand-Response (Auto-DR) Infrastructure

IgCC Section 604 only applies if it is incorporated into the Code under subsection 302.1 by the jurisdiction. If incorporated, this section identifies requirements for a building energy management control system. There are no LEED prerequisites or credits that relate to the requirements of this section, and there is no comparable standard in the Maryland Code.

Technical Analysis

IgCC Section 604 and its subsections require that a building energy management control system be integrated with the HVAC system controls and lighting system controls to automatically reduce the HVAC electric load by at least 10 percent, and the lighting load by at least 15 percent when signaled by the electric utility during a peak current event. The energy management control system must also incorporate rebound avoidance logic that will help to prevent a rebound peak by gradually restoring HVAC and lighting systems to normal operation.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard. If this section is incorporated, it needs to be investigated as to whether the electric utility authority offers a demand response program.

Cost and Time Assessment

Given that there is no comparable standard in the Maryland Code or LEED, if incorporated, the requirements of IgCC Section 604 will result in a minimal increase in project time and costs.

605 Building Envelope Systems

IgCC Section 605 provides prescriptive requirements for the design and construction of building envelope systems to reduce energy consumption. LEED EA Prerequisite 2: Minimum Energy Performance- Options 2 and 3, and EA Credit 1: Optimize Energy Performance- Options 2 and 3 are comparable to this section of the IgCC.

Technical Analysis

To reduce energy consumption, IgCC Section 605 and its subsections require a 10 percent improvement in the insulation and fenestration criteria identified in the Maryland Code, defines improvements to the air leakage requirements of the Maryland Code, and insulation requirements regarding roof replacements. This section also requires that permanent shading devices be provided for all windows within 45 degrees of east, west, or south exposures.

LEED EA Prerequisite 2 requires that a minimum level of energy efficiency for the proposed building be established through either compliance with the prescriptive measures of the ASHRAE Advanced Energy Design Guide appropriate to the project scope, or compliance with the prescriptive measures identified in the Advanced Buildings™ Core Performance™ Guide developed by the New Buildings Institute. EA Credit 1 awards between one and three points for additional energy savings through the ASHRAE Advanced Energy Design Guide or the Advanced Buildings™ Core Performance™ Guide.

The IgCC requirements are more stringent than Maryland Code, and while they are more specific than LEED, the IgCC requirements are only slightly more stringent than the LEED prescriptive requirements because they apply to all buildings where LEED prescriptive requirements only apply to certain types of buildings.

Potential Conflicts with Maryland Regulations

There are no substantial conflicts between IgCC, the existing Maryland Code and LEED.

Cost and Time Assessment

Given that the Maryland Code is less stringent than the IgCC, IgCC Section 605 requirements will have a moderate impact on design and construction costs because they apply to all buildings. This impact would be characterized by an increase in project time and cost. LEED standards following the prescriptive compliance path would likely have the same increase, but LEED prescriptive compliance paths can only be used on certain types of buildings that are under the required size.

606 Building Mechanical Systems

IgCC Section 606 provides prescriptive requirements for the design and construction of building mechanical systems to reduce energy consumption. LEED EA Prerequisite 2: Minimum Energy Performance- Options 2 and 3, and EA Credit 1: Optimize Energy Performance- Options 2 and 3 are comparable to this section of the IgCC.

Technical Analysis

To reduce energy consumption, IgCC Section 606 and its subsections provide a variety of HVAC system requirements, including requirements for heat pumps, ductwork, pipe insulation, economizer systems, kitchen exhaust systems, and laboratory exhaust systems.

LEED EA Prerequisite 2 requires that a minimum level of energy efficiency for the proposed building be established through either compliance with the prescriptive measures of the ASHRAE Advanced Energy Design Guide appropriate to the project scope, or compliance with the prescriptive measures identified in the Advanced Buildings™ Core Performance™ Guide developed by the New Buildings Institute. EA Credit 1 awards between one and three points for additional energy savings through the ASHRAE Advanced Energy Design Guide or the Advanced Buildings™ Core Performance™ Guide.

The IgCC requirements are more stringent than Maryland Code, and while they are more specific than LEED, the IgCC requirements are only slightly more stringent than the LEED prescriptive requirements because they apply to all buildings where LEED prescriptive requirements only apply to certain types of buildings.

Potential Conflicts with Maryland Regulations

There are no substantial conflicts between IgCC, the existing Maryland Code and LEED.

Cost and Time Assessment

Given that the Maryland Code is less stringent than the IgCC, IgCC Section 606 and LEED requirements will both have a low impact on design and construction costs. This impact would be characterized by an increase in project time and cost. LEED would also have a slight increase in time

and cost associated with credit documentation. Under these provisions, the impacts of LEED are slightly higher than IgCC.

607 Building Service Water Heating Systems

IgCC Section 607 provides prescriptive requirements for the design and construction of building service water heating systems to reduce energy consumption. LEED EA Prerequisite 2: Minimum Energy Performance- Options 2 and 3, and EA Credit 1: Optimize Energy Performance- Options 2 and 3 are comparable to this section of the IgCC.

Technical Analysis

To reduce energy consumption, IgCC Section 607 and its subsections require service water heating systems to comply with requirements that are more stringent than the requirements of Maryland Code. It provides requirements for water heater controls, pools, hot tubs, spas, snowmelt systems, and waste water heat recovery systems. It also provides insulation requirements for service water heating piping, and requirements for circulating hot water systems. This section requires that onsite renewable energy and/or heat recovery systems provide at least 25 percent of a pool operation's energy consumption, at least 50 percent of the design space HVAC requirements for pools, hot tubs, and spas, and at least 50 percent of the design snowmelt system peak electric demand load.

LEED EA Prerequisite 2 requires that a minimum level of energy efficiency for the proposed building be established through either compliance with the prescriptive measures of the ASHRAE Advanced Energy Design Guide appropriate to the project scope, or compliance with the prescriptive measures identified in the Advanced Buildings™ Core Performance™ Guide developed by the New Buildings Institute. EA Credit 1 awards between one and three points for additional energy savings through the ASHRAE Advanced Energy Design Guide or the Advanced Buildings™ Core Performance™ Guide.

The IgCC requirements are more stringent than Maryland Code, and while they are more specific than LEED, the IgCC requirements are only slightly more stringent than the LEED prescriptive requirements because they apply to all buildings where LEED prescriptive requirements only apply to certain types of buildings.

Potential Conflicts with Maryland Regulations

There are no substantial conflicts between IgCC, the existing Maryland Code and LEED.

Cost and Time Assessment

Given that the Maryland Code is less stringent than the IgCC, IgCC Section 607 requirements of this section will have a moderate to high impact on design and construction costs, with the requirement regarding pools, hot tubs, spas, and snowmelt systems having a high cost impact. This impact would be characterized by an increase in time and project cost, and will particularly impact rail projects that are provided with switch heaters. By contrast, the LEED requirements would only yield a moderate increase to project time and cost, due to more flexibility within the parameters of EA Prerequisite 2 and EA Credit 1.

608 Building Electrical Power and Lighting Systems

IgCC Section 608 provides prescriptive requirements for the design and construction of building electrical and lighting systems to reduce energy consumption. LEED Prerequisite 2: Minimum Energy

Performance- Options 2 and 3, EA Credit 1: Optimize Energy Performance- Options 2 and 3, and SS Credit 8: Light Pollution Control are comparable to this section of the IgCC.

Technical Analysis

To reduce energy consumption, IgCC Section 608 and its subsections provide requirements for occupancy sensor controls, time switch controls, interior and exterior light reduction controls, daylighting controls, plug load controls, and minimum efficiency requirements for transformers that meet or exceed Maryland Code requirements.

LEED EA Prerequisite 2 requires that a minimum level of energy efficiency for the proposed building be established through either compliance with the prescriptive measures of the ASHRAE Advanced Energy Design Guide appropriate to the project scope, or compliance with the prescriptive measures identified in the Advanced Buildings™ Core Performance™ Guide developed by the New Buildings Institute. EA Credit 1 awards between one and three points for additional energy savings through the ASHRAE Advanced Energy Design Guide or the Advanced Buildings™ Core Performance™ Guide. While SS Credit 8 aims to reduce light pollution, it also reduces building energy consumption as a result by prescribing reduced power to lights and occupant-sensing devices.

While the IgCC requirements are more stringent than Maryland Code, and while they are more specific than LEED, they are only slightly more stringent than the LEED prescriptive requirements because they apply to all buildings where LEED prescriptive requirements only apply to certain types of buildings.

Potential Conflicts with Maryland Regulations

There are no substantial conflicts between IgCC, the existing Maryland Code and LEED.

Cost and Time Assessment

Given that the Maryland Code is less stringent than the IgCC, IgCC Section 608 and the comparable LEED prerequisites and credits both will have a low impact on design and construction costs. This impact would be characterized by a slight increase in time and project cost. LEED would also have a slight increase in time and cost associated with credit documentation. Under these provisions, the impacts of LEED are slightly higher than IgCC.

609 Specific Appliances and Equipment

IgCC Section 609 provides prescriptive requirements for the design and construction of special appliances and equipment to reduce energy consumption. LEED EA Prerequisite 2: Minimum Energy Performance- Options 2 and 3, and EA Credit 1: Optimize Energy Performance- Options 2 and 3 are comparable to this section of the IgCC.

Technical Analysis

To reduce energy consumption, IgCC Section 609 and its subsections provide requirements for elevators, escalators, moving walkways, commercial food service equipment, and conveyors that meet or exceed Maryland Code requirements.

LEED EA Prerequisite 2 requires that a minimum level of energy efficiency for the proposed building be established through either compliance with the prescriptive measures of the ASHRAE Advanced

Energy Design Guide appropriate to the project scope, or compliance with the prescriptive measures identified in the Advanced Buildings™ Core Performance™ Guide developed by the New Buildings Institute. EA Credit 1 awards between one and three points for additional energy savings through the ASHRAE Advanced Energy Design Guide or the Advanced Buildings™ Core Performance™ Guide.

The IgCC requirements are more stringent than Maryland Code, and while they are more specific than LEED, the IgCC requirements are only slightly more stringent than the LEED prescriptive requirements because they apply to all buildings where LEED prescriptive requirements only apply to certain types of buildings.

Potential Conflicts with Maryland Regulations

There are no substantial conflicts between IgCC, the existing Maryland Code and LEED.

Cost and Time Assessment

The requirements of this section will have a low impact on design and construction costs. The IgCC requirements are more stringent than Maryland Code due to an increase in cost and time associated. Though the IgCC requirements are more specific than LEED, the IgCC requirements are only slightly more stringent than the LEED prescriptive requirements because they apply to all buildings where LEED prescriptive requirements only apply to certain types of buildings.

610 Building Renewable Energy Systems

IgCC Section 610 requires building renewable energy systems to be provided and defines requirements for these systems. LEED EA Prerequisite 1: Fundamental Commissioning, EA Credit 2: On-site Renewable Energy, and EA Credit 3: Enhanced Commissioning are comparable to this section of the IgCC. There is no comparable standard in the Maryland Code.

Technical Analysis

IgCC Section 610 and its subsections require that two percent of the total annual energy use of the building and associated site be provided by solar photovoltaic systems, wind energy systems, and/or solar water heating equipment. Alternatives to this are a 10 year commitment to purchase renewable energy credits for at least four percent of the building's total annual energy use, or provide a combination of onsite renewable energy and purchase renewable energy credits for at least four percent of the building's total annual energy use. Solar photovoltaic systems and wind energy systems must be sized to provide not less than two percent of the annual electric energy consumption, and solar water heating equipment must be sized to provide not less than 10 percent of the annual hot water energy usage. Renewable energy systems are also required to be provided with metering and monitoring systems that comply with Section 603.

LEED EA Prerequisite 1 requires that renewable energy systems be commissioned. EA Credit 2, if pursued, provides up to seven points for providing 1, 3, 5, 7, 9, 11, or 13 percent total energy cost reduction from renewable energy sources such as wind and solar systems. Unlike the renewable energy system allowed in IgCC, this credit also allows renewable energy to come from biofuel-based electrical systems, geothermal heating systems, geothermal electric systems, low-impact hydroelectric power systems, and wave and tidal power systems. EA Credit 3 provides an additional 2 points for beginning the commissioning process early in the design phase and executing additional activities after systems performance is completed.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

Given that there is no comparable standard in the Maryland Code, the requirements of IgCC Section 610 will have a high impact on design and construction costs. This impact would be characterized by increased time and cost of the project. EA Credit 2 is often not included in LEED approaches because of the high cost associated with the installation of these systems, maintenance costs associated with these systems, and the difficulty in achieving a reasonable period for the return on the investment. Given the flexibility of the LEED system to omit this requirement from a project, there is no LEED impact associated with the time and cost of the project.

611 Energy Systems Commissioning and Completion

IgCC Section 611 requires commissioning of mechanical and electrical systems. LEED EA Prerequisite 1: Fundamental Commissioning, and EA Credit 3: Enhanced Commissioning, both of which are comparable to this section of the IgCC. There is no comparable standard in the Maryland Code.

Technical Analysis

IgCC Section 611 requires that a commissioning plan be developed, and commissioning be performed for HVAC systems, lighting systems, electrical systems, and building envelope systems under the supervision of a registered design professional. As part of the commissioning process as-built drawings and operation and maintenance manuals must be provided detailing the sequence of controls for the systems. This section also requires Post Occupancy Recommissioning be performed 18 to 24 months after issuance of the certificate of occupancy.

LEED EA Prerequisite 1, and EA Credit 3 require commissioning of these systems under the direction of an independent commissioning authority. The IgCC commissioning requirements are similar to the requirements of LEED enhanced commissioning credit EA Credit 3, with the exception of the requirement to perform recommissioning 18 to 24 months after occupancy. LEED requires that the commissioning authority review building operations with operations personnel within 10 months after occupancy, but does not require retesting of the system that would be necessary to perform recommissioning.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

Given that there is no comparable standard in the Maryland Code, the requirements of both IgCC Section 611 and comparable LEED standards will have a moderate impact on design and construction costs due to developing the plans and performing the commissioning. This impact would be characterized by an increase in both time and cost of the project. LEED would also have a slight increase in time and cost associated with credit documentation. Under these provisions, the commissioning requirements of IgCC are more stringent than LEED.

IgCC Chapter 7 – Water Resource Conservation, Quality, and Efficiency

Chapter Summary

Chapter 7 of the IgCC defines requirements for conserving water, protecting water quality, and providing safe water consumption. It requires that non-potable water be used for many applications where potable water is typically used. The IgCC defines requirements for several different non-potable water sources. None of these non-potable sources are required to be implemented, but due to the IgCC's requirement for reliance on non-potable water, inevitably some will be implemented. In this capacity, the IgCC has stringent regulations for the use of non-potable water systems. The analysis provided for this chapter primarily compares the IgCC with LEED Water Efficiency (WE) prerequisites and credits and Maryland codes from the 2012 International Building Code (IBC), the 2012 International Mechanical Code (IMC), the 2006 National Standard Plumbing Code (NSPC), and the 2007 Supplement to the 2006 NSPC.

Overall, the cost of implementing the IgCC with respect to water resource systems within buildings and building sites would be similar to implementing the same systems under LEED.

701 General

Section 701 outlines the scope of Chapter 7 which is to establish methods of water conservation, protection of water quality, and provisions for safe water consumption. This section does not include any specific regulations.

702 Fixtures, Fittings, Equipment and Appliances

IgCC Section 702 and its subsections regulates water consumption through restrictions of fixtures and fitting flow rates and specifies requirements related to specific equipment and appliances that utilize water resources. LEED WE Prerequisite 1: Water Use Reduction, WE Credit 2: Innovative Wastewater Technologies, and WE Credit 3: Water Use Reduction, and WE Credit 2: Innovative Waterwater Technologies are comparable to this section of the IgCC. Maryland Codes from the 2006 NSPC Chapter 7: Plumbing Fixtures, Fixture Fittings, and Plumbing Appliances; 2007 Supplement to the 2006 NSPC's Chapter 7: Plumbing Fixtures, Fixture Fittings, and Plumbing Appliances; 2012 IBC's Chapter 29: Plumbing Systems also comparable to this section of the IgCC.

Technical Analysis

To reduce potable water consumption, IgCC Section 702 and its subsections set regulations for a wide variety of integrated building components that consume water in their operation. In general, the requirements laid out by the IgCC are more specific than the criteria listed in LEED WE Prerequisite 1 and Credit 3 for fixtures, fittings, equipment and appliances.

The major difference between the IgCC building code and the LEED WE Prerequisite 1 and WE Credit 3 for this Section is that the IgCC sets flowrate regulations for specific fixtures, fittings, equipment, and appliances that may not be exceeded. The LEED rating system requires an overall reduction in the water use for the building which may result in some of the building components consuming greater volumes of water that what is allowed under IgCC per the component. Also, the IgCC building code places regulations on a large variety of building components that consume water in

their operation while the LEED rating system only specifies water use reduction for a limited set of fixtures, fittings, equipment, and appliances.

The LEED WE Credit 2: Innovative Wastewater Technologies - Option 1 can be compared to much of IgCC Section 702. In order to get the two points for this LEED requirement the use of potable water for building sewage conveyance must be reduced through the use of water-conserving fixtures or the use of non-potable water.

Potential Conflicts with Maryland Regulations

There are no substantial conflicts between IgCC, the existing Maryland Code and LEED.

Cost and Time Assessment

Based on Maryland Code as the baseline level of effort, the standards required by the IgCC and LEED would both have a low impact on project cost and time. This impact would be characterized as an increase in time and cost designing plumbing systems to be compliant with those standards. LEED would also have a slight increase in time and cost associated with credit documentation. Under these provisions, the impacts of LEED are slightly higher than IgCC.

703 HVAC Systems and Equipment

IgCC Section 703 regulates water use related to the installation and operation of HVAC systems and equipment. LEED WE Credit 2: Innovative Wastewater Technologies- Option 1 is loosely comparable to this section of the IgCC. Cooling towers, evaporative condensers, and fluid coolers should also comply with the IMC and IBC which represent the Maryland code counterparts to this section.

Technical Analysis

IgCC Section 703 and its subsections set regulations for the use of potable and nonpotable water in HVAC systems. Systems and equipment regulated by this Section include hydronic closed systems, humidification systems, condensate coolers, heat exchangers, cooling towers, evaporative condensers, fluid coolers, wet-hood exhaust scrubber systems, and evaporative cooling systems. The IgCC sets specific water usage regulations for each of these systems and/or pieces of equipment including water volume limitations, equipment location, and acceptable water uses (potable vs. nonpotable). Among these regulations the IgCC requires that all HVAC systems must collect condensate and water discharge for reuse elsewhere on the property. In addition the IgCC requires many instances that nonpotable water be used for cooling operations.

The water that is discharged from HVAC systems and equipment is considered sewage. In this capacity, IgCC Section 703 is somewhat comparable to WE Credit 2, which provides two points for reducing potable water usage for sewage conveyance.

Potential Conflicts with Maryland Regulations

There are no substantial conflicts between IgCC, the existing Maryland Code and LEED.

Cost and Time Assessment

Based on Maryland Code as the baseline level of effort, the standards required by the IgCC and would both have a moderate impact on cost and time associated with the design phase of the project. This impact would be characterized as an increase in time and cost designing HVAC systems

to be compliant with IgCC Section 703. Given the flexibility of LEED to omit HVAC water efficiency measures from a project, there is no LEED impact associated with the time and cost of the project.

704 Water Treatment Devices and Equipment

IgCC Section 704 regulates use and operation of water treatment devices and equipment. The LEED WE Credit 2: Innovative Wastewater Technologies- Option 2 is comparable to this section of the IgCC. The Maryland Code associated with this section of the IgCC is the 2006 NSPC and the 2007 Supplement to the 2006 NSPC: Chapter 7.

Technical Analysis

To reduce potable water usage, IgCC Section 704 and its subsections set regulations for the operation and connection of specific water treatment devices and equipment to the buildings drainage, reuse, and wastewater systems. This section regulates water softener additives, approved water treatment filtration devices, reverse osmosis systems, and the use of onsite reclaimed water treatment systems. The IgCC requires that non-potable water must be used in place of potable water in various subsections of this chapter, and the use of non-potable water often requires prior treatment. The systems identified in this section are not required to be provided, but if provided, these systems must comply with the requirements specified in this section.

LEED WE Credit 2- Option 2 requires that 50 percent of wastewater be treated on-site to tertiary standards in order to earn the two available points. On-site wastewater treatment options identified in the LEED system include packaged biological nutrient removal systems, constructed wetlands and high-efficiency filtration systems.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

Given that there is no comparable standard in the Maryland Code, the standards required by the IgCC and LEED could both have a high impact on cost and time associated with the design and construction of the project. However, water treatment devices and equipment are optional under both standards, and will not impact the project budget or schedule if not implemented.

705 Metering

IgCC Section 705 contains specific water conservation measures for any process where water is consumed from any source within the building or building site. LEED Minimum Program Requirement #6: Must Commit to Sharing Whole-Building Energy, and Water Usage Data is loosely comparable to this section of the IgCC. Remote access is not necessary, but frequently extracted data points are. The LEED credit EA Credit 5 regulates the measurement and verification process for energy monitoring. There is no comparable standard in the Maryland Code.

Technical Analysis

IgCC Section 705 and its subsections require that all potable and nonpotable water supplied to the application of irrigation, tenant spaces, onsite water collection, ornamental water features, pools and in-ground spas, cooling towers, steam boilers, industrial processes, evaporative coolers, fluid coolers and chillers, makeup water for closed loop systems such as chilled water and hydronic

systems, and roof spray systems be individually metered. It also requires remote access to daily metering data with electronic storage and reporting capability.

The LEED criteria that relates to this requirement are the LEED Minimum Project Requirements #6. This requirement specifies that the buildings operation must commit to sharing whole-building energy and water usage data through a free, accessible and secure online tool. However, this LEED criteria does not require individual metering for the various water sources in the building.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

Given that there is no comparable standard in the Maryland Code, the standards required by the IgCC and would both have a high impact on cost and time associated with the design and construction of the project. This impact would be characterized as an increase in time and cost designing and constructing plumbing and individual water source metering to be compliant with IgCC Section 705.

LEED Minimum Project Requirements #6 is much less stringent than the requirements under IgCC, yet the LEED requirements are substantial nonetheless. Accordingly, there would be a moderate impact associated with the time and cost of the project under the LEED system. This impact would be characterized as in increase in time and cost associated with developing a reporting tool for water usage.

706 Nonpotable Water Requirements

IgCC Section 706 contains signage and water quality requirements associated with nonpotable water. There are no associated LEED criteria that require notification when nonpotable water is in use or that set standards for the water quality of nonpotable water. Maryland has no standards for the water quality associated with various end-use applications of nonpotable water.

Technical Analysis

There is no specific design data contained within this section.

Potential Conflicts with Maryland Regulations

There are currently no Maryland codes that specify signage requirements for fixtures, fittings, appliances, and systems utilizing nonpotable water.

Cost and Time Assessment

The implementation of Section 706 of the IgCC would result in a potentially higher cost and design time as compared to the Maryland Code due to metering not currently being regulated. However, this would only be true in scenarios where nonpotable water was used for on-site applications that are not covered under local county ordinances. Based on Maryland Code as the baseline level of effort, the standards required by the IgCC would have a low impact on cost and a moderate impact on time associated with the construction phase of the project. This impact would be characterized as an increase in time and cost developing nonpotable water signage to be compliant with IgCC Section 706.

707 Rainwater Collection and Distribution Systems

IgCC Section 707 regulates the construction, installation, alteration, and repair of rainwater collection and conveyance systems. Under this section collected rainwater may be used for, but not limited to, landscape irrigation. The use of rainwater collected for landscape irrigation directly compares to the LEED WE Credit 1: Water Efficient Landscaping. There are currently no Maryland codes that regulate the collection and distribution of rainwater.

Technical Analysis

IgCC Section 707 and its subsections regulate all facets of rainwater collection, including connections to other water systems, installation, construction materials and methods, system requirements, piping requirements, maintenance, and inspection. This section of the IgCC is designed to cover all rainwater applications from landscape irrigation to treatment as potable water. The use of rainwater harvesting is not required by the IgCC, but when used, the practice must comply with the regulations set by this section.

LEED WE Credit 1 requires a minimum of 50 percent reduction of potable water use for landscape irrigation for 2 points and 100 percent reduction for the full 4 points. The water usage requirements under this credit may be fulfilled in a variety of ways one of which includes the use of captured rainwater.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

Given that there is no comparable standard in the Maryland Code, the standards required by the IgCC and LEED could both have a high impact on cost and time associated with the design and construction of the project. While the IgCC standard is more stringent, the LEED standard will require resources to document the credit. However, rainwater collection and distribution devices and equipment are optional under both standards and will not impact the project budget or schedule if not implemented.

708 Gray Water Systems

IgCC Section 708 regulates the construction, installation, alteration, and repair of gray water reuse systems. The application and use of gray water limited under this section to landscape irrigation (subsurface and surface irrigation applications). This section is directly comparable to the LEED WE Credit 1: Water Efficient Landscaping. The Maryland code associated with this section is the 2006 NSPC Appendix G Graywater Recycling Systems.

Technical Analysis

IgCC Section 708 and its subsections establish comprehensive requirements for the use of gray water in landscape irrigation including permitting, connections to other water systems, installation, system requirements, piping requirements, signage and inspection. Many of these subsections are based off of the International Plumbing Code (IPC), other subsections defer to manufacturer's instructions. The use of graywater is not required by the IgCC, but when used the practice must comply with the regulations set by this section.

The LEED WE Credit 1 requires a minimum of 50 percent reduction of potable water use for landscape irrigation for two points and 100 percent reduction for the full four points. The water usage requirements under this credit may be fulfilled in a variety of ways one of which includes the use of captured graywater.

Potential Conflicts with Maryland Regulations

The 2006 NSPC: Appendix G provides the basis for the existing Maryland Code. There are currently no requirements under this code for water quality minimums per on-site applications that will use treated graywater. To be comparable to the IgCC, Maryland or local jurisdictions would be required to determine standards to implement these practices and update the existing code accordingly.

Cost and Time Assessment

Based on Maryland Code as the baseline level of effort, the standards required by the IgCC and LEED could both have a high impact on cost and time associated with the design and construction of the project. While the IgCC standard is more stringent, the LEED standard will require resources to document the credit. However, graywater systems are optional under both standards and will not impact the project budget or schedule if not implemented.

709 Reclaimed Water Systems

IgCC Section 709 regulates the construction, installation, alteration, and repair of systems supplying nonpotable reclaimed water for landscape irrigation. This section is directly applicable to the LEED WE Credit 1: Water Efficient Landscaping. There are currently no Maryland codes that regulate reclaimed water (recycled sewage) systems.

Technical Analysis

IgCC Section 709 and its subsections establish requirements for the use of reclaimed water in landscape irrigation including permitting, connections to other water systems, installation, system requirements, piping requirements, signage and inspection. Many of these subsections are based off of the International Plumbing Code (IPC).The use of reclaimed water is not required by the IgCC, but when used the practice must comply with the regulations set by this section and its subsections.

The LEED WE Credit 1 requires a minimum of 50 percent reduction of potable water use for landscape irrigation for two points and 100 percent reduction for the full four points. The water usage requirements under this credit may be fulfilled in a variety of ways one of which includes the use of recycled waste water (reclaimed water).

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

Given that there is no comparable standard in the Maryland Code, the standards required by the IgCC and LEED could both have a high impact on cost and time associated with the design and construction of the project. While the IgCC standard is more stringent, the LEED standard will require resources to document the credit. However, reclaimed water systems are optional under both standards and will not impact the project budget or schedule if not implemented.

710 Alternate Onsite Nonpotable Water Sources

IgCC Section 710 establishes requirements for alternate sources of nonpotable water that may be considered for use. There is no LEED prerequisite or credit comparable with this section of the IgCC, and there is no comparable standard in the Maryland Code either.

Technical Analysis

IgCC Section 710 establishes requirements for acceptable sources of nonpotable water including, but not limited to stormwater, reverse osmosis reject water, foundation drain water, and swimming pool backwash water. These alternate sources of nonpotable water can be used for nonpotable purposes if they have been treated to water quality standards established for the jurisdiction in which they will be used.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

Given that there is no comparable standard in the Maryland Code, and since this provision under the IgCC simply requires that alternate nonpotable water sources meet local quality criteria, there would be no cost or time difference associated with the implementation of IgCC Section 710 on a project.

IgCC Chapter 8 – Indoor Environmental Quality and Comfort

Chapter Summary

Chapter 8 of the IgCC covers a variety of topics, from HVAC performance to daylighting that will improve indoor environmental quality and comfort. An emphasis has been placed on measures that will ensure the building is constructed, operated and maintained as designed.

Many of these code requirements are similar to LEED Indoor Environmental Quality (IEQ) requirements, including referencing the same standards. However, the percentage or "threshold" to comply with IgCC tends to be lower. The LEED criteria comparable to this IgCC Chapter are IEQ Prerequisite 2: Environmental Tobacco Smoke (ETS) Control, IEQ Credit 3.1: Construction Indoor Air Quality Management Plan- During Construction, IEQ Credit 3.2: Construction Indoor Air Quality Management Plan- Before Occupancy, and Innovation in Design (ID) Credit: Acoustics.

The majority of these measures defined in the IgCC and LEED would have little to no effect on design, construction cost, or time. However, IgCC Section 807: Acoustics is an optional standard that, has the potential to substantially impact the cost of a project as it calls for specialized material that could increase the size of a building's footprint, depending on the project type.

801 General

This chapter sets standards for developing an interior environment that is conducive to the health of the building occupants. To ensure this is achieved, IgCC Section 801 establishes a requirement for the development of an indoor quality management plan. This plan is required to comply with Sections 802 and 805 below. IEQ Credit 3.1 is comparable to this section of the IgCC. IEQ Credit 3.1 requires that an indoor air quality plan be developed according to the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines For Occupied Buildings Under Construction. This plan also must address specific materials storage and HVAC filter requirements for one LEED point.

802 Building Construction Features, Operations, and Maintenance Facilitation

IgCC Section 802 establishes design standards so the air-handling system and filter racks are easy to maintain once the building is operational. No LEED prerequisite or credit was found to address these service access measures; no comparable standard in the Maryland Code was found either.

Technical Analysis

The requirements of IgCC subsection 802.2 Air-Handling System Access and 802.3 Air-Handling System Filters are engineering "best practices" which require coordination with the Architect during design and Contractor during construction. The requirements include providing unobstructed access ports for the cleaning and repair of components. Unobstructed access is also required to the filter access doors or panels which will have flexible sealant and not require special tools to open.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

Given that there is no comparable standard in the Maryland Code, and given that the IgCC is a "best practice" measure, there should be no cost impact with the implementation of this section.

803 HVAC Systems

IgCC Section 803 establishes standards for indoor air quality during construction and building occupancy. LEED IEQ Prerequisite 2: Environmental Tobacco Smoke (ETS) Control, IEQ Credit 3.1: Construction Indoor Air Quality Management Plan, IEQ Credit 5: Indoor Chemical and Pollutant Source Control, and IEQ Credit 6.2: Controllability of Systems Thermal Comfort are comparable to this section of the IgCC. A portion of the Maryland Code, Maryland 09.12.23 Chapter 23: Environmental Tobacco Smoke Controls also comparable to this section of the IgCC.

Technical Analysis

Both IgCC subsection 803.2 Thermal Environmental Considerations for Human Occupancy and LEED IEQ Credit 6.2, reference ASHRE 55 for ventilated spaces. However subsection 803.2 only requires compliance with ASHRE 55 Section-6.1-Design and -6.2-Documentation. Spaces that have thermal environment performance requirements, such as food storage, natatoriums, shower rooms and drying rooms are exempt from this credit. It is worth noting that LEED IEQ Credit 6.2 also provides a requirement for individual temperature controls for at least 50 percent of the occupants and also has a provision for operable windows. Of these regulations, the LEED requirement is most stringent.

Smoking in buildings is addressed by IgCC subsection 803.3: Environmental Tobacco Smoke Control, LEED IEQ Prerequisite 2, and Maryland 09.12.23 Chapter 23: Prohibition on Smoking in an Enclosed Workplace. All three building standards have similar "no smoking in the building" provisions. IgCC and LEED further define that a designated smoking area outside the building cannot be within 25' of an opening or air intake that could introduce second hand smoke into the building. LEED and the Maryland Chapter 23 give the Owner the option of providing a negatively pressurized smoke room where the air is exhausted directly outside of the building. Of these regulations, the IgCC requirement is the most stringent.

IgCC subsection 803.4: Isolation of Pollutant Sources has similar requirements to LEED IEQ Credit 5. LEED IEQ Credit 5 requires MERV 13 HVAC systems serving occupies space during construction whereas IgCC Subsection 803.5 requires a MERV 11 or higher filter per ASHRAE Standard 52.2. Also, IEQ Credit 5 requires wall off mats from the primary building entrances to reduce the number of pollutants brought into the building which is not covered in this section of IgCC. Of these regulations, the LEED requirement is the most stringent.

Potential Conflicts with Maryland Regulations

There are no substantial conflicts between IgCC, the existing Maryland Code and LEED.

Cost and Time Assessment

Given that the Maryland Code is only partially comparable to the IgCC and LEED standards, the implementation of IgCC would have no significant impact as these standards amount to "best practices." However, the implementation of LEED standards could range from no impact to a moderate impact on project cost and time. This impact would be characterized as in increase in time

and cost associated with optionally designing and constructing individual temperature controls, and/or optionally constructing a negatively pressurized smoke room.

804 Specific Indoor Air Quality and Pollutant Control Measures

IgCC Section 804 regulates indoor air quality of fireplaces and appliances and provides requirements for testing preoccupancy indoor air quality. LEED credit IEQ Credit 3.2: Construction Indoor Air Quality Management Plan- Before Occupancy is comparable to this IgCC section. There is no comparable standard under the existing Maryland Code.

Technical Analysis

IgCC subsection 804.1: Fireplaces and Appliances addresses ventilation requirements and does not have a LEED, IBC or Maryland Code counterpart. The use of unventilated room heaters and unvented decorative appliance, including alcohol based heaters and fireplaces, are prohibited.

IgCC subsection 804.2 Post-Construction, Preoccupancy IAQ Testing requires testing for 35 pollutants after all interior finishes are installed. If the initial test fails to meet the specified levels, mitigation measures can be taken before the test is repeated, or a fourteen (14) day building flush out can be done. This IgCC subsection is comparable with IEQ Credit 3.2, which offers an option of testing for 5 pollutants or performing a building flush out based on air flow volumes. In this case, the IgCC standard is more stringent than LEED requirements.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

Given that there is no comparable standard in the Maryland Code, no additional cost or time is anticipated to meet the requirement of IgCC subsection 804.1 Fireplaces and Appliances. However, the IAQ testing required per IgCC subsection 804.2 would yield a low increase to project budget and schedule, particularly if the test failed and a flush out remediation method is chosen. The LEED standard is considered a less stringent requirement than the IgCC, and would therefore have a negligible impact on project cost or time.

805 Prohibited Materials

IgCC Section 805 prohibits the use of asbestos containing materials and urea-formaldehyde foam insulation. There is no comparable LEED prerequisite or credit. There is no comparable standard in the Maryland Code.

Technical Analysis

Both asbestos and urea-formaldehyde foam insulation are on the Living Building Challenge (LBC) “Red List” of materials to avoid. Note that the LBC prohibits use of all formaldehydes. The IgCC’s approach of limiting the scope to asbestos and urea-formaldehyde foam insulation is a sensible approach as there are a variety of high-performing insulations currently on the market that are urea-formaldehyde.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

Given that there is no comparable standard in the Maryland Code, this IgCC requirement would not substantially impact project time or cost due to the fact that asbestos-free and urea-formaldehyde free materials are more commonplace in the market.

806 Material Emissions and Pollutant Control

IgCC Section 806 regulates the allowable VOC emissions levels for composite wood products, adhesives, and sealants, paintings and coatings, flooring, acoustical ceiling tiles and wall systems, and insulation. LEED IEQ Credit 4.1: Low Emitting Materials-Adhesives and Sealants, IEQ Credit 4.2: Low Emitting Materials-Paints and Coatings, IEQ Credit 4.3: Low Emitting Materials-Flooring Systems, IEQ Credit 4.4: Low Emitting Materials-Composite Wood and Agrifiber Products, and IEQ Credit 4.6: Low Emitting Materials-Ceilings and Wall Systems are all comparable to this section of the IgCC. There is no comparable standard in the Maryland Code.

Technical Analysis

Under this section, the requirements of the IgCC and LEED materials requirements are similar. The main difference between IgCC and LEED for these material categories is the method of calculations. To meet the requirements of IgCC, 85 percent of materials by volume or weight must comply with the specified VOC levels provided. This is a departure from the LEED requirement that all materials should meet the VOC limits. Nominally, the LEED requirements are more stringent.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

Given that there is no comparable standard in the Maryland Code, and Designers and Contactors who have worked on sustainable projects are familiar with the specifying, installing, and tracking interior materials to meet the requirement of this section. There should be no substantial cost or time impacts to projects under the IgCC or LEED.

807 Acoustics

IgCC Section 807 provides optional standards to mitigate sound transmission between rooms, interior sound levels caused by mechanical equipment and generators, structure-borne sounds, and testing for compliance. There is no comparable LEED prerequisite or credit. There is no comparable standard in the Maryland Code either.

Technical Analysis

In IgCC subsection 807.1, buildings where the interior is open to the exterior, parking structures, and concession stand and toilet facilities (Groups A-4 and A-5) are exempt from meeting the acoustical standards provided in subsection 807.2. All other structures need to comply.

IgCC subsection 807.3 provides limits for outdoor and indoor noise levels created by mechanical equipment and generators. The outdoor levels are determined by a maximum weighted sound level for day time and night time in relation to adjacent property. For all buildings except factory, industrial or storage buildings adjacent to a similar occupancy, the mechanical equipment or

electrical generators have a maximum day time limit of 65 dB and a night time limit of 55 db. Emergency electrical generators only need to comply with the daytime limit.

The building Owner shall hire an approved agency to verify compliance with this section, applicable laws, and ordinances and construction documents. Any discrepancies shall be brought to the attention of the design professionals and code official prior to the completion of that work. A final report documenting required testing, corrective actions needed and taken and containing copies of previous reports shall be submitted to demonstrate compliance. Note that testing reports are not needed for approved assemblies with established STC ratings.

While there is no comparable LEED prerequisite or credit to this section of the IgCC, the project could qualify for an Innovation in Design Credit under the LEED system, potentially earning one point. It is worth noting that LEED for Schools and this section of the IgCC use the same ANSI/ASA standard for schools.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

Given that there is no comparable standard in the Maryland Code, there will be a moderate cost increase for most projects that opt to comply with the IgCC Section 807, based on the requirement for more substantial wall assemblies. Due to the size of the wall assemblies, a slightly bigger building would be required to maintain the same net square footage. For a simple building with few rooms this increase will be not be noticeable. By contrast, for a multi-story building with many interior rooms, the cumulative addition of an inch or more per partition will create a noticeable need to add more square footage to the building. The IgCC requirement for third party testing also contributes to the increase in project cost.

While IgCC Section 807 will add cost to larger projects, there should be no increase in time during the design phases of the project. The testing required by the IgCC is part of the commissioning process; while this will add another layer of testing the Contractor needs to coordinate, it should have no to low impact of the project schedule.

808 Daylighting

IgCC Section 808 regulates the quality and minimum quantity of daylight interior spaces will receive based on a prescriptive or performance method to determine compliance. LEED IEQ Credit 8.1: Daylight and Views – Daylight and IEQ Credit 8.2: Daylight and Views – Views are both comparable to this section of the IgCC. There are no comparable standards in the Maryland Code.

Technical Analysis

IgCC Section 808 requirements apply to most building types in occupancy groups A-3, B, E, F, S and portions of group M, as identified in the IgCC. For buildings 2 stories or less, at least 50% of the floor area is required to achieve daylighting; for buildings more than 2 stories tall, at least 25% of the floor area is required to achieve daylighting. Under this standard, signage or displays on the exterior of a building above the third floor shall not interfere with providing daylight. Conversely, signage or

displays on the ground floor and floor above it are allowed to interrupt the daylight for the space to accommodate wayfinding and store signage.

LEED IEQ Credit 8.1 provides four options for meeting the Daylight and Views requirement. The first two options are based on either a prescriptive or performance method, similar to the IgCC. However, LEED also allows two additional methods of compliance. IEQ Credit 8.1- Option 3 allows direct measurement of values taken in the building and IEQ Credit- Option 4 allows a combination, of two or more of the other options together. Under the LEED requirements, at least 75% of regularly occupied spaces much achieve daylighting.

Based on an analysis of percentages alone, the LEED credit is more stringent. However, it is possible that projects could exist here where 25 percent of the net floor area could equal or be greater than 75 percent of all regularly occupied spaces; in this case the IgCC could be considered the most stringent.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

Given that there is no comparable standard in the Maryland Code, the cost impact will vary from none to moderate depending on the building standard applied and the building type. Typical office buildings will comply with minimum to no change in the fenestration. The design of a transportation facility, on the other hand, could require more windows than a typical facilities building to comply, and would therefore result in a net project cost increase. For the purpose of this analysis, however, the IgCC and LEED will be considered equally stringent, and implementation of these standards would yield no anticipated increase in project cost or time on average.

IgCC Chapter 9 – Commissioning, Operation, and Maintenance

Chapter Summary

Under Chapter 9 of the IgCC, commissioning is required for all buildings; there are no exceptions. The IgCC sections covered in under this chapter are all comparable to LEED EA Prerequisite 1: Fundamental Commissioning of Building Energy Systems, and EA Credit 3: Enhanced Commissioning. There are no comparable standards under the existing Maryland Code.

In general, Chapter 9 of the IgCC and the referenced ASHRE 189.1 standard[1] meet the requirements of both EA Prerequisite 1 and EA Credit 3. The IgCC and LEED have slightly different requirements but the intent and major requirements are the same – to ensure that the building operates as designed. For example, the IgCC requires a preoccupancy final commissioning report to be completed prior to certificate of occupancy application. Achieving both can be done without adding cost to meet the IgCC requirements. Additional Owner project requirements should be added to the commissioning and operations and maintenance (O&M) manuals on a project by project basis.

901 General

The intent of Chapter 9 is to establish minimum commissioning and O&M requirements to ensure that the building is constructed, operated and maintained as designed. This section does not include any specific regulations.

902 Approved Agency

IgCC Section 902 establishes how code official is permitted to be the approved agency to lead the commissioning process. EA Prerequisite 1 and EA Credit 3 establish the parameters under the LEED system for identifying a commissioning authority to lead the commissioning process. There is no similar standard under the existing Maryland Code.

Technical Analysis

IgCC Section 902 establishes that the code official is the party in charge of determining the eligibility of a commissioning agent as an "approved agency." Qualifications and examples of completions of similar projects as well as a list of possible conflicts of interest must be as submitted for the code official's approval. It is clear that an approved agency must not be involved in the project construction activities but may be involved in the project design. The code official can act as an approved agency.

LEED EA Prerequisite 1 and EA Credit 3 requirements for an approved agency vary from the IgCC by allowing for a larger pool of qualified experts. This list includes the registered design professionals/architect and engineers, engineers of record, as well as independent companies. This section elaborates that experience with similar projects or training will be part of the evaluation of the code official in determining an approved commissioning agent/agency.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

[1] Sections 101.3 Scope and 301.1.1 Application incorporate compliance with ASHRE 189.1 as a code requirement.

Cost and Time Assessment

Given that there is no comparable standard in the Maryland Code, the parameters for establishing a commissioning authority under both the IgCC and LEED are essentially "best practices." Therefore, there is no anticipated cost or time impact of the project based on the requirements of these standards.

903 Commissioning

IgCC Section 903 provides a minimum Commissioning Plan for all projects, including requirements and timing of preoccupancy and post-occupancy commissioning activities. LEED EA Credit 3 also establishes a Commissioning Plan and Commissioning Specification for all projects. There is no similar standard under the existing Maryland Code.

Technical Analysis

A Commissioning Plan organized by IgCC Chapters is incorporated into the code via Table 903.1, (see Appendix B). The plan identifies the minimum systems and elements that will be commissioned, when each activity will occur, who is responsible for commissioning and if it is a preoccupancy and/or post-occupancy report requirement. Deficiencies identified in the initial commissioning report shall be corrected or brought to the attention of the owner and code official. This is a departure from LEED where the commissioning reports go only to the owner. The IgCC requires the preoccupancy report to be delivered to the owner, registered design professional, and the code official upon request. The preoccupancy final commissioning report is part of the submittal requirements to obtain a Certificate of Occupancy.

The post-occupancy commissioning report is required to be completed in phases with copies of the final report given to the owner and to the code official upon request within 30 months after the Certificate of Occupancy was issued.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

Given that there is no comparable standard in the Maryland Code, the requirements of IgCC Section 903 are beyond that of EA Prerequisite 1 thus there will be a low to moderate additional cost for the Owner to hire a commissioning agent and to produce additional reports for most projects. It is not clear if there will be an additional review cost or increase of current review fees to accommodate commissioning review required by the code official. This may vary from jurisdiction to jurisdiction.

The provided Commissioning Plans provide a clear directive on the time of activities which the Design Team and Contractor can easily incorporate into the schedules without effecting the project completion time. The Contractor will need to coordinate with the independent commissioning agent to ensure adequate time is provided to correct deficiencies found in preoccupancy preliminary reports prior to the application for the Certificate of Occupancy.

904 Building Operations and Maintenance

Under IgCC Section 904, specific requirements are given for the development and distribution of projects record documents, and O&M manuals. LEED EA Prerequisite 1 and EA Credit 3 also establish a

Commissioning Submittal Review and a Systems Manual for all projects. There is no similar standard under the existing Maryland Code.

Technical Analysis

IgCC subsection 904.3 requires O&M manuals to be delivered from the Contractor to the owner prior to the application for the Certificate of Occupancy. The owner must then write a letter stating that they have received the completed O&M manuals as part of the application for the Certificate of Occupancy. While providing O&M manuals is part of the contractors typical scope of work, this requirement is a change in culture, as it is now being required earlier in the schedule and tied to the owners ability to use the building.

Record documents that the owner must maintain at least one copy of under the IgCC include:

- Approved construction documents – drawings and specifications;
- As-built plans and specifications indicating actual field conditions where they vary from the construction documents, especially of concealed items;
- Report of brownfield or site remediation when applicable; and
- Certificate of Occupancy.

The cover of each record document shall include that the owner must maintain a copy of this document. Similarly the cover sheet of the O&M manuals must state that at least one copy of the manuals will be in the possession of the owner or occupant.

The building O&M documents must include manufacture's specifications and recommendations, programming procedures and data points, narratives, and other means of communicating to the owner how the site, building, and systems are intended to be maintained and operated. In general this includes replacement, cleaning and maintenance schedules, as well as material care and maintenance instructions. Subsection 904.3 details the minimum items to be included in the O&M per the IgCC chapter. The items shaded on Appendix B: Table 903.1 Commissioning Plan have related O&M requirements.

Comparable requirements under EA Credit 3 are established for the production of a systems manual that gives future operating staff the information needed to understand and optimally operate the commissioned system. This systems manual is a separate document from the O&M manuals submitted by the contractor.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

Given that there is no comparable standard in the Maryland Code, requiring the development and issuance of operation and maintenance manuals as well as some level of building facility training on installed HVAC equipment is a design and construction best practice. There will be a low cost and time impact on the project completion, whether implemented under the IgCC or the LEED system.

IgCC Chapter 10 – Existing Buildings

Chapter Summary

Chapter 10 under the IgCC identifies which existing structures shall comply with new construction requirements and which are required to comply with the provisions of this chapter. This chapter also provides exceptions for existing conditions to make compliance with the IgCC possible and practical. In all of these cases the modification needs to comply as much as possible with the requirement. There has clearly been an effort made in this chapter of the IgCC to not make renovations so expensive that upgrades are not completed or requiring extensive modifications.

The scope of work is covered mainly in two ways under this chapter of the IgCC: requirements that are specified in this section and requirements that reference other IgCC sections that existing building shall comply with. The standards covered by this section relate to energy performance in mechanical systems and building insulation. The additional scope required by this chapter may include metering of energy and water usage, automatic timer for HVAC systems, outside air economizer, and roof insulation. The cost impact to the project will range from moderate to high depending on the scope and budget of the project.

Only one section, 1006 Demolition, is directly comparable with a requirement under the LEED system. The other sections address prerequisites or credits topics and will contribute to the overall efficiency of the building through water savings, energy management and operations and maintenance requirements. There are no references to the International Existing Building Code (IEBC), there are however a few to the IECC.

1001 General

IgCC Section 1001 defines in broad strokes which types of projects shall comply with this chapter for existing buildings, operation and maintenance, compliance and existing conditions. This section does not include any specific regulations.

1002 Additions

IgCC Section 1002 states that additions to any site-built building or structures must comply with the new construction portion of this code. There is no comparable LEED prerequisite or credit. There is no comparable standard in the Maryland Code either.

Technical Analysis

IgCC section 1002 clarifies that any additions to an existing building are subject to the new construction portion of the IgCC, and that any addition to a modular building that is relocated within or into a jurisdiction that is in compliance with requirements or approvals in effect at the time of construction must also comply with the code for new construction.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

This section of the IgCC continues to define which structures need to meet the existing building requirements, and thus has no direct cost or time implications.

1003 Alterations to Existing Buildings

IgCC Section 1003 is the most substantial section in this chapter, providing the majority of specified requirements. Portions of this IgCC section are comparable to LEED NC standards including EA Prerequisite 3: Fundamental Refrigerant Management, EA Credit 1: Optimize Energy Performance, and EA Credit 5: Measurement and Verification. There is no comparable standard in the Maryland Code.

Technical Analysis

IgCC Section 1003 establishes that all existing buildings, assemblies and/or systems being altered as part of the project scope of work must comply with this chapter. Unless specifically mentioned, existing conditions may remain unaltered.

IgCC Sub-subsection 1003.2.1: Metering Devices, conditionally requires that metering or submetering be installed to measure at least one of eleven elements specified within the code. This requirement for metered devices is comparable to LEED EA credit 5, which requires an energy measurement and verification plan, in the case that energy is being monitored through this IgCC sub-subsection..

IgCC Sub-subsection 1003.2.2: Heating, Ventilating and Air-Conditioning, conditionally requires that time clock switch controls are provided for HVAC equipment, functional outside air economizers are provided on cooling systems, and HVAC piping and ducts comply with IgCC sections 606.3 and 606.4 for energy efficiency. IgCC Sub-subsection 1003.2.2 is indirectly comparable with LEED EA Prerequisite 2, which requires that a minimum level of energy efficiency for the proposed building be established through either compliance with the prescriptive measures of the ASHRAE Advanced Energy Design Guide appropriate to the project scope, or compliance with the prescriptive measures identified in the Advanced Buildings™ Core Performance™ Guide developed by the New Buildings Institute. IgCC Sub-subsection 1003.2.2 is also indirectly comparable to EA Credit 1 awards between one and three points for additional energy savings through the ASHRAE Advanced Energy Design Guide or the Advanced Buildings™ Core Performance™ Guide.

IgCC Sub-subsection 1003.2.3: Service Water Systems, establishes minimum insulation values and control limitations for hot water tanks, pipe insulation, circulator pumps, and water fixture flow rates. IgCC Sub-subsection 1003.2.3 is indirectly comparable with LEED EA Prerequisite 2, which requires that a minimum level of energy efficiency for the proposed building be established through either compliance with the prescriptive measures of the ASHRAE Advanced Energy Design Guide appropriate to the project scope, or compliance with the prescriptive measures identified in the Advanced Buildings™ Core Performance™ Guide developed by the New Buildings Institute. IgCC Sub-subsection 1003.2.3 is also indirectly comparable to EA Credit 1 awards between one and three points for additional energy savings through the ASHRAE Advanced Energy Design Guide or the Advanced Buildings™ Core Performance™ Guide.

IgCC Sub-subsection 1003.2.4: Lighting requires that lighting systems and equipment shall comply with the IECC. IgCC Sub-subsection 1003.2.4 is comparable to LEED EA Prerequisite 2, which requires

that a minimum level of energy efficiency for the proposed building be established through either compliance with the prescriptive measures of the ASHRAE Advanced Energy Design Guide appropriate to the project scope, or compliance with the prescriptive measures identified in the Advanced Buildings™ Core Performance™ Guide developed by the New Buildings Institute. IgCC Sub-subsection 1003.2.4 is also indirectly comparable to EA Credit 1 awards between one and three points for additional energy savings through the ASHRAE Advanced Energy Design Guide or the Advanced Buildings™ Core Performance™ Guide.

IgCC Sub-subsection 1003.2.5: Swimming Pools and Spas, requires that heated swimming pools are equipped with a cover, backwash systems be based on pressure drop, pool/spa recirculation pumps are operated via a time clock, and heaters are cleaned and tuned annually. There is no comparable LEED prerequisite or credit to this IgCC Sub-subsection.

IgCC Sub-subsection 1003.2.6: Insulation of Unconditioned Attics, requires buildings up to three stories above grade to provide insulation of an R-value required by the IgCC directly above conditioned spaces. IgCC Sub-subsection 1003.2.7: Roof Replacement Insulation, addresses entire roof replacement where there is less than 16 percent slope and insulation is above deck must meet the insulation requirements of IECC. In both cases where existing space limitations prevent enough insulation to be installed without impacting the existing functions to meet these requirements as much insulation shall be installed as space allows. There is no comparable LEED prerequisite or credit to these IgCC Sub-subsections.

Potential Conflicts with Maryland Regulations
The Maryland Code does not include a comparable standard.

Cost and Time Assessment
Given that there is no comparable standard in the Maryland Code, and that the scope of a project under this IgCC chapter can vary widely, and that many of the provisions in this IgCC chapter are either indirectly or loosely comparable to the LEED system, it is difficult to contrast the impact of IgCC and LEED on the time and cost of a project. However, IgCC Subsection 1003.2 limits the IgCC renovation cost to 10 percent of the total project budget. In this regard, the impact of IgCC on project time and cost can be considered less stringent than the LEED system.

1004 Change of Occupancy

IgCC Section 1004 requires that changes in Occupancy from one IBC occupancy category or within the same group comply with subsections 1001.3 Compliance and 1001.4 of this chapter, excepting historic buildings as defined in Subsection 1005 below.

Technical Analysis
As a scoping section of the IgCC there is no technical analysis

Potential Conflicts with Maryland Regulations
The Maryland Code does not include a comparable standard.

Cost and Time Assessment
As a scoping section of the IgCC there is no direct impact on cost or time.

1005 Historic Buildings

IgCC Section 1005 establishes that for renovations or modification of historic buildings, each section of this chapter should be evaluated individually to determine if compliance can be achieved without affecting the historic character. Where this is not possible historic buildings and structures are not required to make alteration that will negatively affect the historic aesthetic or functional aspects of the project.

Technical Analysis

This is a scoping section that limits alterations to maintain historic resources.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

As a scoping section of the IgCC, this section has no direct cost or time impacts.

1006 Demolition

IgCC Section 1006, Deconstruction and Demolition establishes a requirement to divert a minimum of 50 percent of material from landfills. A construction waste management plan is also required per IgCC Subsection 503.1. LEED MR Credit 2: Construction Waste Management is directly comparable to this section of the IgCC. There is no comparable standard in the Maryland Code.

Technical Analysis

IgCC Section 1006 is directly comparable to LEED MR Credit 2. Both of these standards establish a minimum requirement of 50 percent waste diversion from landfills. Under the LEED standard, diverting 50 percent of waste from the landfill will achieve one point, whereas diverting 75 percent of waste from the landfill will achieve two points.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

Under both IgCC and LEED there is a low anticipated impact on the cost and time designing and constructing a project. This impact would be characterized by a small increase in cost and time segregating demolition waste for diversion from the landfill; however, it is possible that cost savings can be realized through the reuse of those materials or the potential to sell them at market.

1007 Jurisdictional Requirements

IgCC Section 1007 is an optional part of the construction code. Subsection 1007.2 provides an opportunity to have an existing building reviewed for compliance with this code as part of the application for alterations. Subsection 1007.3 defines reporting requirements for Zero Energy Performance Index, peak monthly energy demand, and Annual CO2 emissions. LEED EA Credit 5: Measurement and Verification is somewhat comparable to Subsection 1007.3 of the IgCC. There is no comparable standard in the Maryland Code.

Technical Analysis

IgCC Subsection 1007.2 defines the method the code official will use to determine certification of existing buildings in compliance with this code. It does not require modifications outside of the project scope to make the existing building compliant. When available, previously approved documents, including construction document drawings and specifications, will be used to determine compliance. When previously approved documentation is not available, portions of concealed elements will be exposed for field verification by the code official to determine compliance. In this case, existing buildings are not required to meet material VOC levels of Section 806. Once the evaluation is done, in either situation, a certificate of compliance will be issued. Items that are not in compliance will be listed on this certificate when applicable. This is one way to evaluate and catalog the sustainable attributes of existing building stock.

IgCC Subsection 1007.3 was established to provide a uniform method of reporting and displaying energy usage and emissions of buildings. This is an ongoing requirement to show compliance with IgCC sections 601 and 602.

LEED EA Credit 5 provides 1 point for measurement and verification of actual energy savings through building operations. EA Credit 5 requires at least one year of reporting post-occupancy, whereas the IgCC requires continual reporting by the owner or the owners authorized agency post occupancy. This portion of the LEED Measurement and Verification requirements is less stringent than the IgCC, and is only loosely comparable to the entire scope of IgCC Section 1007.

Potential Conflicts with Maryland Regulations

If Maryland Department of Transportation (MDOT) requires this section, indication of the appropriate government or local agency that will receive and keep a record of the annual zEPI, peak monthly energy report and annual CO2 emissions for all projects is needed. Each building needs to be reported separately. Similarly, building and the site usage needs to be reported separately. A complete report will document these three matrixes for the previous year and be submitted on or before March 1 of the following year.

Cost and Time Assessment

Given that there is no comparable standard in the Maryland Code, a slight increase in cost and time would likely occur as the result of a review defined by subsection IgCC 1007.2. If projects are required to allow a code official to spot check for compliance in the field, a most moderate cost and time increase would occur since repair work to the exposed areas will be required.

IgCC Chapter 11 – Existing Building Site Development

Chapter Summary

Chapter 11 of the IgCC provides regulations regarding additions and alterations to existing and historic building sites. This chapter is not comparable to any LEED prerequisites or credits, but does have similar regulations to the Maryland Code under the IEBC. However, the IEBC is intended for buildings and not building sites. In order to align with the IgCC, Maryland Code would require a slight revision to include building sites under the existing regulations. The impact of the regulations in this chapter is low and is primarily associated with the materials required to provide new bicycle parking to an existing site.

1101 General

IgCC Section 1101 provides a general description of Chapter 11, it defines the applicability of the chapter and states that the provisions of the chapter shall control the alteration, repair, maintenance and operations of existing building sites and the alteration to building site improvements. While there is no comparable LEED prerequisite or credit, the Maryland Code, through the adoption of the IEBC, has similar requirements under Section 301.2.

1102 Additions

IgCC Section 1102 provides regulations regarding additions to building site improvements and is intended to define required compliance of such additions. While there is no comparable LEED prerequisite or credit, the Maryland Code provides a similar requirement in Section 1001 of the IEBC.

Technical Analysis

IgCC Subsection 1102.1 states that additions to any building site improvements shall comply with the requirements of the IgCC for new construction.

Potential Conflicts with Maryland Regulations

IEBC Subsection 1001.1 states that additions to buildings shall comply with codes adopted for new construction. This is similar to the IgCC section; however, it is intended to be applied to building additions and not building site additions. The Maryland Code may require a slight revision to clarify that the building addition standard is to apply to building site additions as well.

Cost and Time Assessment

Using Maryland Code as the baseline level of effort, time, and cost for a project, the standards required by the IgCC would not impact the cost or time of the project because no additional processes, staff, or materials are needed to meet the requirements. There is no LEED prerequisite or credit that is comparable and therefore LEED would not impact the cost or time of a project under these provisions.

1103 Alterations to Existing Building Sites

IgCC Section 1103 provides regulations regarding alterations to existing building sites and is intended to define required compliance of such alterations. While there is no comparable LEED prerequisite or credit, the Maryland Code provides a similar requirement in Section 601 of the IEBC.

Technical Analysis

IgCC Subsection 1103.1 states that alterations to existing building sites shall be in accordance with the IgCC so that the site is no less conforming to the IgCC than prior to alterations. Subsection 1103.2 states that where existing hardscapes are altered, the alterations shall comply with the provisions of the IgCC.

Potential Conflicts with Maryland Regulations

IEBC Subsection 601.2 states that a building shall not be altered so that it is less safe than its existing condition. This is similar to the IgCC section; however, it is intended to be applied to building alterations and not building site alterations. The Maryland Code may require a slight revision to clarify that the building alteration standard is to apply to building site alterations as well.

Cost and Time Assessment

Using Maryland Code as the baseline level of effort, time, and cost for a project, the standards required by the IgCC would not impact the cost or time of the project because no additional processes, staff or materials are needed to meet the requirements. There is no LEED prerequisite or credit that is comparable and therefore LEED would not impact the cost or time of a project under these provisions.

1104 Change of Occupancy

IgCC Section 1104 provides regulations regarding change of occupancy of a building or tenant space and is intended to define compliance of the space based on the new occupancy. There is no comparable LEED prerequisite or credit, and there is no comparable standard in the Maryland Code.

Technical Analysis

IgCC Subsection 1104.1 states that where a change in the use or occupancy of a building or tenant space places it in a different division or different occupancy, the building shall comply with subsection 1104.2. Subsection 1104.2 requires that bicycle parking shall be provided where a change in occupancy results in an increase in the occupant load, including short-term and long-term bicycle parking.

Potential Conflicts with Maryland Regulations

The Maryland Code does not include a comparable standard.

Cost and Time Assessment

Using Maryland Code as the baseline level of effort, time, and cost for the project, the standards required by the IgCC would have a low impact on the cost of the project. This impact would be an increase in the cost of the project and is associated with additional materials required to provide bicycle parking. There is no LEED prerequisite or credit that is comparable and therefore LEED would not impact the cost or time of a project under these provisions.

1105 Historic Building Sites

IgCC Section 1105 provides regulations regarding historic building sites and is intended to preserve the historic quality and character of the site. While there is no comparable LEED prerequisite or credit, the Maryland Code provides a similar requirement in Section 1101 of the IEBC.

Technical Analysis

IgCC Subsection 1105.1 states that the provisions of the IgCC relating to the construction, repair, alteration, addition, and restoration of building sites shall not be mandatory for historic building sites where compliance would conflict with the historic nature of the site.

Potential Conflicts with Maryland Regulations

IEBC subsection 1101.2 requires that a written report is to be filed to identify areas of code compliance and areas where compliance would be damaging to the contributing historic features. This is similar to the IgCC, as it does not require compliance in cases where historic character would be compromised.

Cost and Time Assessment

Using Maryland Code as the baseline level of effort, time, and cost for a project, the standards required by the IgCC would not impact the cost or time of the project because no additional processes, staff or materials are needed to meet the requirements. There is no LEED prerequisite or credit that is comparable and therefore LEED would not impact the cost or time of a project under these provisions.

Appendix A: Codes and References Table

The codes and references used in the analysis for this document are listed below:

Code	Year
Leadership in Energy and Environmental Design (LEED) for New Construction and Major Renovations	2009
International Building Code (IBC)	2012
International Green Construction Code (IgCC)	2012
International Energy Conservation Code (IECC)	2012
2006 National Standard Plumbing Code (NSPC)	2006 with 2007 Supplement
International Existing Building Code (IEBC), 2012 (Chapters 8, 9 and 10)	2012
International Existing Building Code (IEBC), 2009 (Chapters 4, 5 and 11)	2009
Baltimore County Building Code	2012
Maryland Stormwater Design Manual	2009
Maryland Standards and Specifications for Soil Erosion and Sediment Control	2011
Maryland Building Performance Standards COMAR	2012
Maryland Smoke-Free Workplace Laws 09.12.23, Chapter 23	1995
Montgomery County Executive Regulation – Residential and Commercial Recycling issued by Dept. of Public Works & Transportation	2005

Appendix B: Table 903.1 Commissioning Plan

TABLE 903.1
COMMISSIONING PLAN

CONSTRUCTION OR SYSTEM REQUIRING VERIFICATION	PREOCCUPANCY	POST-OCCUPANCY	METHOD	OCCURRENCE		SECTION/ REFERENCED STANDARD
				Preoccupancy	Post-occupancy	
Chapter 4: Site Development and Land Use						
Natural resources and base line conditions of building site	X	None	Report	With permit submittal	None	401.2
Landscape irrigation systems	X	None	Field inspection	Installation	None	404.1, 405.1.1
Topsoil and vegetation protection measures; setbacks from protected areas	X	None	Field inspection and report	Installation of measures, prior to other site disturbance	None	405.1.1
Imported soils	X	None	Field inspection and report	With permit submittal; after all-fill operations complete	None	405.1.3
Soil restoration and reuse	X	None	Field inspection and report	Preparation and replacement of soils	None	405.1.4
Stormwater management system operation	None	X	Field inspection	—	24 months	403.1
Erosion and sediment control	X	X	Field inspection	During construction activities	Periodic for 24 months	405.1.1
Hardscape and shading provided by structures and vegetation	X	X	Field inspection and report	During construction and installation	24 months	408.2
Vegetative roofs	X	X	Field inspection and report	Installation of protective membranes, base materials, soils and vegetation	24 months	408.3.2
Site lighting	X	None	Testing and report	Installation	None	409
Chapter 5: Material Resource Conservation and Efficiency						
Moisture control (Section 507.1)						
1. Foundation sub-soil drainage system.	X	None	Field inspection and verification	Periodic inspection for entire sub-soil drainage system	None	507.1 and IBC Ch 18
2. Foundation waterproofing	X	None	Field inspection and verification	Periodic inspection for the entire foundation	None	507.1 and IBC Ch 18
3. Foundation dampproofing	X	None	Field inspection and verification	Periodic inspection for the entire foundation	None	507.1 and IBC Ch 18
4. Under slab water vapor protection	X	None	Field inspection and verification	Periodic inspection for entire slab footprint	None	507.1, IBC Ch 19 and ASTM E 1643
5. Flashing at: exterior windows, doors, skylights, wall flashing and drainage systems	X	None	Field inspection and verification	Periodic inspection for not less than 25 percent of all flashing locations.	None	507.1 and IBC Ch 14
6. Exterior wall coverings	X	None	Field inspection and verification	Periodic inspection for not less than 25 percent of exterior wall cladding systems.	None	507.1 and IBC Ch 14
7. Roof coverings, roof drainage, and flashings	X	None	Field inspection and verification	Periodic inspection for not less than 25 percent of roof covering, roof drainage and flashings.	None	507.1 and IBC Ch 15

(continued)

TABLE 903.1—(continued)
COMMISSIONING PLAN

CONSTRUCTION OR SYSTEM REQUIRING VERIFICATION	PREOCCUPANCY	POST-OCCUPANCY	METHOD	OCCURRENCE		SECTION/ REFERENCED STANDARD
				Preoccupancy	Post-occupancy	
Chapter 6: Energy						
Energy consumption, monitoring, targeting and reporting						
a. Monitoring system	X	None	Inspection and verification	During construction and prior to occupancy	None	603, 610.5
b. Calibration	X	X	Testing and review and evaluation or test reports	During commissioning	Annually	603, 610.5
Mechanical systems completion – all buildings						
a. Air system balancing – provide the means for system balancing	X	None	Inspection and verification	During construction and prior to occupancy	None	611.1.2.1 and through reference to IECC
b. Hydronic system balancing – provide means for system balancing	X	None	Inspection and verification	During construction and prior to occupancy	None	611.1.2.2 and through reference to IECC
c. Mechanical system manuals – construction documents to require O&M manual	X	None	Verification of construction documents	Plan review	None	611.1.5.2
Mechanical systems – buildings over 5,000 square feet total building floor area						
a. Commissioning required and noted in plans and specifications	X	None	Verification of construction documents	Plan review	None	611.1
b. Documentation of required commissioning outcomes	X	None	Verification with the building owner	Subsequent to completion of all commissioning activities	None	611.1
c. Preparation and availability of a commissioning plan	X	None	Verification with the RDP or commissioning agent	Between plan review and commissioning initiation	None	611.1.1
d. Balance HVAC systems (both air and hydronic)	X	X	HVAC system installer/contractor or commissioning agent	After installation of HVAC systems and prior to occupancy	TBD	611.1.2
e. Functional performance testing of HVAC equipment	X	X	HVAC system installer/contractor or commissioning agent	After installation of HVAC systems and prior to occupancy	TBD	611.1.3
f. Functional performance testing of HVAC controls and control systems	X	X	HVAC system installer/contractor or commissioning agent	After installation of HVAC systems and prior to occupancy	TBD	611.1.3.2
g. Preparation of preliminary commissioning report	None	X	HVAC system installer/contractor or commissioning agent	None	Subsequent to commissioning	611.1.4

(continued)

TABLE 903.1—(continued)
COMMISSIONING PLAN

CONSTRUCTION OR SYSTEM REQUIRING VERIFICATION	PREOCCUPANCY	POST-OCCUPANCY	METHOD	OCCURRENCE		SECTION/ REFERENCED STANDARD
				Preoccupancy	Post-occupancy	
h. Acceptance of HVAC systems and equipment/system verification report	None	X	Building owner	None	Letter verifying receipt of the commissioning report	611.1.4.1
i. Preparation and distribution of final HVAC system completion—Documentation that construction documents require drawings, manuals, balancing reports and commissioning report be provided to the owner and that they have been provided	None	X	RDP, contractor or commissioning authority	None	90 days after final certificate of occupancy	611.1.5
Chapter 6: Lighting						
Auto demand reduction control system functionality	X	X	Functional testing	Final inspection	18-24 months	604.4
Plug load controls	X	None	Functional testing	Final inspection	None	608.6
Connection of appliances to switched receptacles	—	X	Field inspection	None	18-24 months	608.6
Specified transformer nameplate efficiency rating	X	None	Field inspection	Final inspection	None	608.8.1.1
Verification of lamp	X	X	Field inspection	Final inspection	18-24 months	608.10
Verification of ballast	X	None	Field inspection	Final inspection	None	608.10
Lighting controls						
a. Installation	X	None	Field inspection	Post-installation	None	608.11
b. Calibration	X	X	System installer/contractor or commissioning agent	Post-installation	18-24 months	611.3.3
Chapter 7: Water Resource Conservation, Quality and Efficiency						
Appliances	X	None	—	—	—	702.6
Hot water distribution	X	None	—	—	—	702.8
Cooling tower performance	—	X	—	—	—	703.7.7
Metering	X	None	—	—	—	705.1.1
Rainwater system water quality	None	X	Field testing and verification	None	707.15.1	707.15.1
Gray water system water quality	None	X	Field testing and verification	None	708.13.8	708.13.8
Soil percolation test	X	None	Field inspection and report	Prior to installation of gray water irrigation system	None	708.14.2

(continued)

TABLE 903.1—(continued)
COMMISSIONING PLAN

CONSTRUCTION OR SYSTEM REQUIRING VERIFICATION	PREOCCUPANCY	POST-OCCUPANCY	METHOD	OCCURRENCE		SECTION/ REFERENCED STANDARD
				Preoccupancy	Post-occupancy	
Chapter 8: Indoor Environmental Quality and Comfort						
Building construction, features, operations and maintenance facilitation						
Air-handling system access	X	X	Field inspection and verification	During construction and prior to occupancy	18 - 24 months	802.2
Air-handling system filters	X	X	Field inspection and verification	During construction and prior to occupancy	18 - 24 months	802.3
HVAC systems						
Temperature and humidity in occupied spaces	—	X	Field inspection and verification	—	18 - 24 months	803.2
Specific indoor air quality & pollutant control measures						
Listing, installation and venting of fireplaces and combustion appliances	X	—	Field inspection and verification	During construction and prior to occupancy	—	804.1
Sound transmission						
Mechanical and emergency generator equipment located outside buildings or located where exposed to exterior environment.	X	None	Field testing and verification	See Section 807.5.1	None	807.5.1
HVAC background sound	X	None	Field testing and verification	See Section 807.5.2	None	807.5.2

For SI: 1 square foot = 0.0929 m^2.

Commissioning items that have related O & M requirements